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"Reflections on Genius."

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My first words must necessarily be an expression of sincere thanks to the Association for the great honour they have done me in electing me their President for the ensuing year. In the interval since this was proposed I have often reflected on the number of eminent men who have filled the Presidential chair with great distinction, only to become more conscious of my inadequacies to reach the standard they have set.

Tradition has decreed that one of the earliest duties of a new President is to deliver to you a Presidential Address. Surprisingly enough, no set pattern for this has ever been established, though the majority have contributed from their years of mature experience, and we have benefited thereby. In recent years we have been privileged to welcome to this session a large number of guests who, while having psychiatric interests, are not wholly absorbed in our speciality. In deciding on a subject of general psychiatric interest I was led to consider what special problem could be found in one's work in a hospital such as that of which I have the good fortune to be in charge.

I need hardly remind you of the role of the Registered Hospitals. They have been in existence for many years—most of them for over a century, some for much longer. They are self-supporting, non-profit making hospitals, and have been maintained by endowments and fees paid by patients in accordance with their means. St. Andrew's Hospital was founded in 1833, and the original regulations decreed that care and treatment was to be offered to those whose education and refinement rendered them able to appreciate the benefits of private care, yet not able to pay for such. Obviously many patients have been drawn from the professional classes, and throughout those years there have been many of rare gifts and achievements in the literary, artistic and scientific spheres. Invariably we regard the duty of the psychiatrist as dealing with breakdown or failure. Inevitably this is so, yet it is interesting and illuminating to reflect on the contributions that have been made during periods of illness, and this is the purpose of this address, which I have entitled "Reflections on Genius." I am fully aware that I have the opportunity of studying a selected group, and I am not endeavouring to tabulate the frequency with which instability is found among those of outstanding ability. I propose merely to cite certain instances of association between eminence, in one or other sphere, and nervous instability where the latter has been an important factor in creating drive.

There is no satisfactory definition of genius. The Oxford Dictionary defines it as "Native intellectual power of an exalted type: extraordinary capacity for

imaginative creation, original thought, invention or discovery." Obviously it should not be confused with talent. In spite of the popular definition, "an infinite capacity for taking pains," no amount of perseverance or labour added to talent can ever create a genius. Henderson states that genius in its truest and greatest sense is a multiple quality, it has many facets, and associated with it there must be sufficient energy to accomplish what has been conceived. Kretschmer has given a more comprehensive definition: "We shall give the name genius to those men who are able to arouse permanently, and in the highest degree, that positive, scientifically grounded feeling of worth and value in a wide group of human beings. But we shall only do so in those cases where the value arises with psychological necessity, out of the special mental structure of the bringer of value, not where a stroke of luck or some coincidence of factors has thrown it in his lap."

For many generations the belief was held that there was a close correlation between genius and mental illness. Aristotle, centuries ago, drew attention to the frequency with which those eminent in the arts were the victims of melancholia. A similar association, no doubt, prompted Dryden to write:

"Great wits are sure to madness near allied,
And thin partitions do their bounds divide."

Towards the end of the last century more attention seems to have been focused on the subject, though not of a highly critical nature. I need hardly remind you of the writings of Lombroso, Nisbet, and of Nordau about this time, all of whom emphasized the abnormality of genius, Nisbet maintaining that genius was directly proportional to the degree of instability. Their views were, in effect, a reiteration of ancient beliefs, and called forth much criticism from various people. In 1895 Bernard Shaw, in his own inimitable style, attacked their concepts in "The Sanity of Art" and ridiculed their psychological deductions. About this time Galton gave support—amended some years later—to the view that genius and mental illness were not closely related, and pleaded for more detailed observation and more precise methods of psychological investigation and assessment.

More recently Terman and Cox have stressed that persons of genius always come from the ranks of the gifted (I.Q. 140 or over), and have maintained that the alleged eccentricity of genius is largely a myth. This reduced the conception of genius to intellectual capacity with no other components, a simplification not readily acceptable. Havelock Ellis regarded the genius as one who possessed a complex and sensitive nervous system developed along special lines, and an innate organic aptitude which prevented him from adapting himself to the ordinary activities of life. Russell Brain recently, in his Galton lecture, admitting that the genius was abnormal by virtue of an abnormal nervous system, considered that this was due to its being richer, not quantitatively in nerve cells, but in the organization of these with functional patterns termed "schemas." Many geniuses have a more highly developed capacity for verbal symbols and attain a higher level in conceptual or abstract thought. By the possession of this increased variety and number of these schemas blending feeling with a high intelligence the genius operates at a high level in his particular field, be it art, music, poetry or literature.

The complications of the problems are apparent and no satisfactory solution is at present in sight. There appear to be several variables, including ability, drive, an increased nervous sensibility and maybe other factors at present unrecognized. It is the particularly favourable combination of such that makes the genius and, similarly, the interaction of these factors that arouses nervous tendencies reflected in eccentricities.

As you are aware, many famous names in music, art and literature have been the victims of quite definite and severe physical illness. That they were able to accomplish their work in defiance of their disability is a matter of considerable interest, and naturally one on which there are divergent views. Temperamental factors or personality traits are reflected, to a considerable degree, in their work.

Among those who come to mind as having made valuable contributions, while suffering from a physical disorder, are Sullivan, Keats, Ruskin, de Quincey, Goethe, the Brontës, Jane Austen, Symonds, Chopin, Robert Louis Stevenson, Francis Thompson, and D. H. Lawrence. Of the actual diseases from which they have suffered tuberculosis is certainly the most common, and it seems to be especially common in literary genius. It is unfortunate that more details are not

available of the physical disorders from which they suffered. It would not appear that the quality of their work was influenced by whether they had a rapidly progressive illness or a slow one. Keats, who died of tuberculosis at the age of 26, was in the former group, Ruskin and de Quincey, in the latter, while Stevenson's illness ran a middle course. De Quincey in his *Confessions of an Opium Eater* tells us, "It was not for the purpose of creating pleasure but of mitigating pain in the severest degree that I first began to use opium as an article of diet." He gives his opinion of the relative value of opium and alcohol in these words: "As I do not readily believe that any man having once tasted the divine luxuries of opium will afterwards descend to the gross and mortal enjoyment of alcohol I take it for granted—

"That those eat now, who never ate before
And those who always ate, now eat the more."

Much of his best work was accomplished during an acute phase of his illness, and in his confessions he gives vivid details of his symptomatology and his amazing form of dream phantasy.

Sullivan, we are told, composed much of his music during spells of the most agonizing pain, and John Ruskin wrote parts of *Modern Painters* and *The Seven Lamps of Architecture* during acute exacerbations of his illness. This was so, too, of Robert Louis Stevenson. He has given us a more elaborate description of his symptomatology and, from a psycho-pathological aspect, it is rich in detail. In one passage of self-analysis, written during a quiescent phase, he provides a vivid description of a lack of mental stability and moral force certainly over-compensated during a recrudescence.

He showed that irresponsible over-activity so characteristic of his illness and often exposed himself to physical dangers. He often travelled with only a great-coat and a toothbrush. Manhood consisted of getting rid of material attachments: "As long as you were bound down to anything—house, umbrella or portmanteau—you were still tethered to the umbilical cord." He believed that a "robust vice, an energetic state of sinning was better than a state of negation." Yet he was not without insight, for shortly after writing "we want to burn everlastingly upwards" he adds—"while life burns ever more intensely—my real strength wanes and my days decrease."

Rest advocated was referred to as "a vegetable existence so irksome as to irritate my spirit beyond endurance." This keen subjective self-analysis persisted, and at one stage he writes, "It seems a phase of my disease that I should grow in youth and spiritual intensity inversely to my physical decay." In the latter phases of his illness he appeared to realize that nothing could be done to avert the inevitable, and while pursuing his literary work with feverish energy he writes rather pathetically, "What is to become of a soul so intensely young in its old ruined body consuming its last drop of vital oil with the flame of beauty?" Again he writes, "There is nothing more difficult to communicate on paper than this baseless ardour, this stimulation of the brain, this sterile joyousness of spirits—yet it is notable that you are hard to root out of your bed, that you start forth singing, indeed on your walk, yet are unusually ready to return home again." Colvin tells us that Stevenson had periods of great gloom and depression followed by periods of over-activity and recklessness. He has given a vivid description of one of these depressive phases and the whole picture is characteristic of the cyclothyme. What is the relationship between tuberculosis and genius? Much has been written about this. We know that tuberculosis was exceedingly common in the last century, and while the disease has, no doubt, a stimulating effect by an increased metabolic activity, there is no evidence that it is a cause or determinant of genius. The temperamental and personality factors remain predominant.

Varying degrees of nervous instability amounting in several instances to mental illness have been observed, not infrequently, in others with no concomitant physical illness. Of those who come to mind are Rousseau, Newton, Robert Mayer, Tasso, Kleist, Strindberg, Cowper, Clare, Rethel, Van Gogh, Schumann and Hugo Wolf. If we consider less severe disturbances we might include many more, such as Michelangelo and Byron, whose careers show an abrupt alternation of success or failure, despair or disappointment, and of recurrent conflicts and violent scenes. The frequency with which authors have been abnormally preoccupied with the state of their bodily health is surprising. Many have been convinced that they would

die young, others that their reason was in danger. Dean Swift was greatly haunted by this fear, as also was Dr. Johnson. This abnormal preoccupation has been more conspicuous among poets. As has been shown by both Nicholson and Brain, there is no statistical evidence to support the view that poets die young, and their expectation of life does not differ materially from that of the average citizen.

It is of considerable interest that two of those known to have suffered from definite psychotic illnesses should have lived within a short radius of this borough. I refer to William Cowper and John Clare. The form of their illnesses had much in common, as is apparent from an examination of their clinical condition. Several biographies of both men have been written, and to these I am indebted for most of the details of their lives.

William Cowper was born in 1731, and was the son of an Anglican clergyman. Though much sheltered in early life by his mother he had the advantage of a much better education than Clare. Cowper's mother died when he was six years of age and he was sent to a preparatory school. There he became solitary and much tormented by other boys. Subsequently he went to Westminster School, which he enjoyed, and he was a good scholar. To please his father he qualified as a solicitor, but hated this work. He developed a self-reproachful depressive illness, made three suicidal attempts, and was admitted to a private mental home under Dr. Cotton in St. Albans, where he remained about two years. On recovery he gave up law, became much interested in evangelism, and was absorbed with religious preoccupations. We are told his life was a sort of ecstasy, and during this period he took to the writing of hymns. In all he wrote 67 hymns, his best known being "Oh, for a closer walk with God." His last hymn, "God moves in a mysterious way His wonders to perform," is said to have been written after the frustration of one of his several plans to commit suicide. The death of his brother caused another relapse, and he again became acutely depressed and agitated. This phase persisted for over two years and from it he made a slow recovery. Then followed his literary period when he produced, among numerous other works, *John Gilpin* and his great work *The Task*, which ensured his fame. However, as he describes it, "The heavens are only opened to shut again," and once more he became depressed. These phases recurred at intervals, and for the last six years of his life he was persistently depressed. Much of his writing at this time had a depressive content, as exemplified by a poem he wrote on his window shutter before leaving Weston for Norfolk.

"Farewell dear scenes forever closed to me:
Oh for what sorrows must I now exchange ye."

The award of a pension of £300 per annum in 1794 did not materially relieve his symptoms and they persisted till his death in 1800.

It is surprising that so talented an author as Harold Nicolson in his Lloyd Roberts lecture on "The Health of Authors" should show such a meagre and uninformed interpretation of mental illness as exemplified by his observations on Cowper's state of health. He writes, "It cannot be said that Cowper was ever a demented maniac; the worst that could be said of him was that he was sometimes sadly confused in the head." A more characteristic picture of a manic-depressive psychosis would be difficult to describe.

John Clare was born at Helpston, a village in this county, in 1793. He was one of twins born to parents of the farm labouring class. His parents, we are told, were anxious to see him rise in the social scale, and as he had a keen mind he was allowed to remain at school until about the age of 13, his schoolmaster showing a particular interest in him. In adolescence he developed a desire for solitude—considered to be the result of a passion for nature. He would sit for hours absorbed in the activities of birds and beasts. He was regarded by the locals as an oddity and an idler. He appears to have spent much time in phantasy formation, and it was not unusual for him to go through the village muttering to himself. At such times it is said he frequently imagined himself to be a hero in battle or a traveller in a foreign land. The strange glances of passers-by recalled him to reality and filled him with shame.

His first poem appears to have been written when he was about 14, though this is not certain. The villagers knew of his love of rhyming and this, together with his abstracted manner and the practice of talking to himself, led the more uncharitable to say he was mad. His reaction to alcohol, even in small amounts,

was excessive, and under its influence he became noisy and excited. At the age of 17 he developed epileptiform attacks. Little is known of the nature of these and we are told that after a year or two they cleared up. He was then obsessed with great fears which he referred to as "the blue devils." His more definite depressive phases troubled him in his early twenties and persisted on and off for the rest of his life. In these phases he drank excessively. His symptoms were typically depressive; in one letter he wrote, "I keep getting a little better and a little worse, remaining at last just as I was. I was very bad this morning but have recovered this evening as I generally do." These phases were followed by those of mild elation. In one of his subsequent letters he boasts that he has had no alcohol for two years, that he feels hale and hearty and quite recovered from his last ailments. In such periods he wrote furiously and made schemes for greater success. Alas, they were only to be followed by further depression, various phobias and the thought of everlasting damnation. So it continued until 1837—when he was admitted to a private home in Epping Forest in a state of acute depression, with self-reproachful depressive ideas. He is said to have improved under treatment, and it was thought that if only a pension could be obtained for him, giving him that added security, all would be well. This never materialized. He had phases of over-activity and developed further delusional ideas. He imagined himself to be a prize fighter, associated himself with Byron and called himself Boxer Byron, suggestive of a mild manic episode. In July, 1841, he escaped and walked to his home—a distance of 80 miles in three days. He remained there only six months. Much of that time he was mute and catatonic and certification was inevitable. He was admitted to Northampton General Lunatic Asylum, now St. Andrew's Hospital, in December, 1841.

Unfortunately his earlier medical notes are missing, and such as I have seen are scanty and lacking in clinical details. For prolonged periods he was depressed followed by more rational episodes; later he became excitable and considered himself to be a prize fighter, but no one would take him on. He was Shakespeare and Byron all in one. For long periods he was able to go into the town and sat in the alcove of All Saints' Church writing but saying little; he was considered very taciturn. His illness was progressive. He became more deluded and expressed delusional ideas of the involutional type—"they have cut off my head and picked out all the letters of the alphabet—all the vowels and consonants—and brought them out through my ears." Dementia was progressive, and apoplexy was the cause of death in May, 1864.

I have dealt in greater detail with this form of illness than might appear to have been necessary. This, however, was deliberate, as there are conflicting views regarding his type of illness. In my opinion this was a cyclothymic disorder, and not a schizophrenic one as suggested by one of his most recent biographers. Apart from the actual symptomatology, the excellence of much of his poetry written in hospital and the slow development of deterioration support this diagnosis. In my experience a prolonged schizophrenic illness in a talented person produces such deterioration as to interfere markedly with any subsequent creative work. This has been observed frequently, and was brought home a few years ago in the case of a young musician of tremendous promise who had already thrilled his audiences and was said to have the world at his feet. Modern therapeutic measures did not abort his schizophrenic illness and he has done nothing of value since.

Miss Wilson points out in her biography *Green Shadows* that Clare provides one of the clearest examples of how inescapable is the destiny of a poet. She points out that he had not, when he began to write, any knowledge of the poetry that had gone before, he inherited no tradition and knew no stimulus from the company of intellectuals. He did not choose to be a poet—he wrote because he had to. His first volume, *Poems Descriptive of Rural Life and Scenery*, was published in January, 1820. It had a very favourable reception, and four editions, each of 1,000 copies, were printed before the end of that year. His second volume, *The Village Minstrel*, appeared in the September of 1821 and was less successful. It is interesting, in passing, to note the wealth of poets alive about this time, including Wordsworth, Coleridge, Southey, Byron, Shelley, Keats, and Scott, and the galaxy of talent to command the attention of readers contributed to Clare's lack of success. His third volume, *Shepherd's Calendar*, appeared in April, 1826, and was a failure—only 425 copies were sold in two years. Poetry was said to have gone out of fashion and the book trade was at a low ebb. A fourth volume, *The Rural Muse*, was pub-

lished in July, 1835, and did not materially relieve his economic plight. Having married in 1820 he had by now 7 children and poverty accompanied him throughout his life. Economic difficulties were great, and his type of personality was not such as to cope adequately with his problems.

Dr. Wing in his annual report of 1864 refers to some verses Clare wrote long after his admission to the Asylum, which show the degree of intellectual preservation, together with the deep melancholy under which he must have laboured at the time they were written. They are :

- " I am : yet what I am none cares or knows,
 My friends forsake me like a memory lost,
 I am the self-consumer of my woes—
 They rise and vanish in oblivious host,
 Like shadows in love's frenzied, stifled throes :-
 And yet I am, and live—like vapours tost
- " Into the nothingness of scorn and noise,
 Into the living sea of waking dreams,
 Where there is neither sense of life or joys,
 But the vast shipwreck of my life's esteems ;
 Even the dearest, that I love the best,
 Are strange—nay, rather stranger than the rest.
- " I long for scenes where man hath never trod,
 A place where woman never smiled or wept—
 There to abide with my Creator, God,
 And sleep as I in childhood sweetly slept,
 Untroubling and untroubled where I lie,
 The grass below—above the vaulted sky."

Where has this now led us, and what can be said of the view that genius is allied to mental illness? That certain men of genius have been mentally afflicted is undoubted, but such statistical data as are available shows that the relationship has been over-stated. Havelock Ellis found an incidence of insanity including senile disorders of 4.2 per cent. among 1,030 British men of genius, and less than 2 per cent. were reported to have insane parents or children. Brain refers to the high incidence among poets. He found that 15 per cent. of 150 poets born since 1700 were known to have been either insane or grossly psychopathic. More recently Juda has published the results of an investigation into the relationship between highest mental capacity and psychic abnormalities among 294 of the leading German artists and scientists of the 18th and 19th centuries. There was a much higher incidence of psychoses and psychoneuroses in geniuses and their families. Schizophrenia was found to be more common in artists, and manic-depressive psychosis in scientists in a frequency ten times the incidence of the general population. The eccentrics were correspondingly more prevalent among the artists, and the emotionally unstable psychopaths more frequent among the scientists.

We have discussed briefly the nervous organization of a person of genius. As Scarlett puts it—it presupposes a special nervous sensibility which reacting to experience manifests itself not only in receptivity to inspiration but also creates great mental conflicts. From that conflict emerge reactions and conduct which may be labelled neurotic or psychopathic, and also a drive which linked with unusual ability finds avenues of original expression. Geniuses in all spheres have acknowledged their debt to this process of inspiration, maintaining that their work has originated in ideas that have developed in the mind without conscious effort. Scarlett quotes Shelley on this point: "The mind in creation is as a fading coal which some invisible influence like an inconstant mind awakens to transitory brightness. Could this influence be durable in its original beauty and force, it is impossible to predict the greatness of the results, but when composition begins inspiration is already on the wane."

Various techniques have been developed by various writers to encourage the elaboration of such ideas. It seems to be accompanied by a sense of supernatural vitality, and the extent of the experience may result in some dissociation from reality and even hallucinations. Clare was alarmed at times to find how completely it controlled him and drove him on to write for days on end, scarcely stopping to eat or sleep until everything was drained from him. There is little doubt that the cyclothymic temperament with its phase of over activity, flight of ideas and

ability to transcribe clearly can add to the productivity of the genius. It may be that when the creative mood passes or inspiration is lacking there develops a consequent sense of depression and failure.

While there is little evidence to support the view of any direct correlation between genius and insanity such as would require care and treatment in a hospital for nervous diseases, there is no doubt about the frequency with which neurotic or psychopathic symptoms are seen in this group. I have already referred to the possible mechanism, but no direct explanation can yet be offered. It has been said that when the wife of a famous scientist was received by the King of Sweden, she responded to a sympathetic inquiry about her late husband with the remark, "Your Majesty, he was intolerable." If biographers had the honesty of this woman I am sure that this assessment would be frequently repeated.

Would the removal of such symptoms of psychopathy—assuming that one day we may know how—be of material gain? This, I fear, must remain a hypothetical question—one on which none of us would like to express an opinion. Are we not in much the same position as when Sir Edmund Gosse in his essay on Swinburne wrote these words: "It is impossible not to see that the absolutely normal man or woman, as we describe normality, is very rarely indeed an inventor, or a seer, or even a person of remarkable mental energy. The bulk of what are called entirely 'healthy' people add nothing to the sum of human achievement, and it is not the average navvy who makes a Darwin, nor the typical daughter of the plough who develops into an Elizabeth Barrett Browning. There are probably few professional men who offer a more insidious attack upon all that in the past has made life variegated and interesting than the school of robust and old-fashioned physicians who theorize on eccentricity, on variations of the type, as necessarily evil and obviously to be stamped out, if possible by the State. The more closely we study, with extremely slender resources of evidence, the lives of great men of imagination and action since the beginning of the world, the more clearly we ought to recognize that a reduction of all the types to one stolid uniformity of what is called 'health' would have the effect of depriving humanity of precisely those individuals who have added most to the beauty and variety of human existence."

PERSONALITY AND VISUAL PERCEPTION: A REVIEW.

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It has become increasingly apparent in recent years that perception may afford a valuable approach to the study of personality. In this growing awareness several converging trends may be distinguished, which have their origin in different branches of study.

In the first place, those psychophysicists, physicists and physiologists, of Fechnerian persuasion, who have done so much to advance our knowledge of the general principles that govern perception, have been forced to admit the influence of autistic and motivational factors, even at the level of "pure" sensory research. Associated with this admission has been the development of differential psychology in which, instead of dismissing individual differences as being due to experimental errors of measurement, attention was focused on these differentiating qualities *per se*. In this country and in America, as shown by the work of Galton (99) and Cattell (42), individual differences were first regarded as a means for measuring intellectual abilities, but later in both countries, and particularly on the Continent, it was realized that they might prove more effective as measures of temperamental characteristics. By studying the interrelations among different modes of perceptual response, continental writers such as Jaensch (139) and Kretschmer (167), to name but two, have attempted to develop empirical typologies.

Yet another influence may be discerned in the recent tendency for psychoanalytic theory to become more "ego-oriented," and this movement, described as one from "depth" to "surface" (95), has been accompanied in some quarters by the belief that psychoanalytic concepts, such as the various defence mechanisms, may be submitted to experimental test by deducing their consequences in the perceptual system. Finally, although few seem to be aware of this influence, ophthalmologists (8, 55, 66, 273) are paying greater attention to the effect of personality and functional disorders on the visual system; this development is, of course, associated with the establishment of psychosomatic medicine as a branch of medical science.

In the belief that a survey of existing knowledge in this new field of perception-personality relationships would be of some value to research workers, the present paper has been written. While no claim to comprehensiveness is made, it is felt that the review is broad enough in scope to serve as an introduction to the subject.

As this review has been undertaken from within the framework provided by Eysenck's (80) researches on personality, it is necessary at the outset to indicate briefly the sort of theoretical model which underlies his work. Personality is defined (following Warren (302) and MacKinnon (204)) as "the integrated totality of character, temperament, intellect and physique. In this definition character is conceived as the more or less enduring and consistent pattern of a person's conation; temperament as his more or less enduring and consistent pattern of affection; intelligence as his more or less enduring and consistent pattern of cognition" (82, p. 199). As a result of a number of experimental and statistical studies Eysenck (79) has produced a geometrical model in which the three psychological terms in this definition, character, temperament, and intellect, denote three more or less orthogonal axes of personality. The conative factor contrasts the well-adjusted individual on the one hand with the maladjusted individual on the other, the affective factor contrasts the introvert with the extravert, while the cognitive factor is identified with general intelligence. More recently, following Eysenck's (84) test of Kretschmer's theories, it appears that a further dimension should be included on the orectic side, namely "normality-psychoticism." So far, Eysenck has failed to verify Kretschmer's dimension of cyclothymia-schizothymia, but he does not regard the issue as finally settled.

This scheme results from an approach to personality which is dimensional, frankly atomistic, and has the unusual merit that it is based on experiment. It is capable of extension and development in various directions to embrace further hypotheses of personality structure as they are verified. The picture of personality organization that emerges from each fundamental dimension is a hierarchical one (see Eysenck's diagram (80, p. 29)), the essential underlying concept being, as in other hierarchical schemes, integration, while the main higher-order concepts that Eysenck makes use of are "trait" and "type," distinguishable in terms of increasing generality.

In terms of this general scheme, the present review attempts to cover most of the literature, clinical, experimental, and theoretical, that has a fairly direct bearing on the measurement of orectic factors in personality (i.e., those non-cognitive factors usually regarded as personality factors proper).

Having defined what we shall understand by personality in this paper we turn next to the other main term, perception, and here it will be noted that the review confines itself entirely to visual perception. There are two reasons for this. First, it is chiefly the correlations between vision and personality that have received attention both in clinical and experimental studies and in theoretical discussion. Secondly, it seems likely that vision provides a more direct approach to personality organization, particularly for the clinical psychologist, than other aspects of the perceptual system, for not only is the visual apparatus the most highly specialized, but it contains all the functional components that are likely to reflect orectic factors of personality. As Gillespie puts it, "The visual apparatus presents great possibilities of symptomatic reaction to psychological stress. It is a kind of homunculus, a *mulum in parvo*, since it contains within itself all the varieties of functional components upon which emotional events can be reflected. All the fundamental lessons of 'psychosomatic medicine' . . . can be applied to or deduced from functional disorders of the visual apparatus."

"The functions of this apparatus comprise *sensation, voluntary movement, and involuntary movement* of unstriated muscle. We can therefore expect to find psychogenic disorders of sensation in the form of any degree of diminution of visual acuity up to complete blindness, based . . . on the psychological fact that the patient does not wish to see; or we can find inadequacy of muscular adjustment and co-ordination because the patient does not wish to look" (102, p. 41).

In restricting the review to visual behaviour the author has, at the same time, extended it beyond what some readers would regard as the legitimate province of perception, by including both sensory and motor factors. This is of no moment, for the classifications which suit the purposes of workers in separate departments will almost certainly conflict with the classifications that will eventually be arrived at by students of personality. It is, for instance, likely that much of what is now regarded as visual behaviour by sensory psychologists will eventually be subsumed under the concept of "autonomic balance" by personality science.

No attempt will be made to divide the field into many divisions and subdivisions, but the review will be presented in four main parts. The first deals with different

visual and motor functions or abilities that appear to be of value for personality study; the second part deals with perceptual attitudes (i.e., higher-order concepts, presumably organized at the trait level (see 80, p. 29)); while the third part of the review concerns recent theoretical developments. Finally, a number of general conclusions are drawn.

I. PERCEPTUAL FUNCTIONS.

(a) *Dark vision*.—Aspects of visual functioning that appear to be most promising for personality study are night visual capacity and dark adaptation for, in addition to the objective stimulus conditions (318), organic (66) and other factors with which these abilities are connected, a number of writers have noted the importance of personality factors of an orectic nature. Thus, Smith (269), Derby (59), Duke-Elder (66), Livingston and Bolton (182), Wittkower *et al.* (316), Campbell and Cross (41), Davenport (55), Ironside and Batchelor (136) and Stephenson and Cameron (271) have all distinguished a neurotic type of night-blindness.

One of the first systematic studies of the relation between dark adaptation and neuroticism was that of Wittkower *et al.* (316), who examined 52 unselected soldiers complaining of night-blindness. It was found that 42 of these subjects suffered from various types of psychological disorder, and a disturbance in dark adaptation, as determined by the Nagel adaptometer, was found in 15 cases out of 40; on the other hand, in a control group of 33 only two subjects showed defective dark vision. No evidence of vitamin A deficiency was found, and the authors concluded that "most cases of night blindness seen in . . . Britain . . . are probably of psychological origin."

A more extensive investigation of the relationship between defective dark vision and neuroticism was undertaken by Livingston and Bolton (182), using the Livingston Hexagon test. In this test, 32 separate elements, including letters and simple objects in the proportion of six to two, are presented to the subject for identification after 30 minutes' dark adaptation. The subject records his responses upon a writing board holding Braille type paper for guidance. Four tests were given at different levels of illumination (ranging from 0.00015 eq. foot candles to 0.0012 eq. foot candles), with one minute allowed in each case for recording responses. A fifth test was given to detect malingerers or individuals suffering from hysterical amblyopia. This test consists of three large capital letters exposed against a background the illumination of which enables them to be read easily except by patients with advanced pathological conditions.

Of the 50 patients who were examined, 30 suffered from anxiety states, 15 from depressions with allied anxiety state in five, two were hysterics, one was an epileptic, one was obsessional, and there was one case of psychopathic migraine. A control group of 50 normals was selected at random from the score cards of 40,000 R.A.F. personnel who had taken the test. It was found that the average score for the neurotic group was 9.6 as compared with 19 for the control group, the maximum score being 32 and the minimum 0. Of the 30 patients with anxiety states, 10 who had previously complained of night-blindness obtained scores of 4, while the remaining 20 produced an average score of 8; the 15 depressives averaged 13 marks, the two hysterics scored zero, the obsessional scored 26, the epileptic 14, and the patient suffering from psychopathic migraine obtained 8 marks.

Rees (237) gave the Livingston test to a group of 96 neurotic male patients, including 36 anxiety states, 33 depressives, and 27 hysterics. Results obtained from this group were compared with the results of 6,062 R.A.F. personnel who had taken the same test. It was found that the average score of the neurotic group was 7.1, while the average score of the normal group was 19.3 on a scale ranging from 0 to 32; the average of the neurotic group was more than three standard deviations below the average of the normal group. Turning next to the three neurotic groups themselves, the anxiety states had an average score of 4.8, the depressives of 7.9, and the hysterics of 8.7; whereas 81 per cent. of the anxiety states scored below average, only 67 per cent. of the depressives and 63 per cent. of the hysterics were below average, while for the neurotic group as a whole 72 per cent. were below average. It appears from these results that anxiety states are particularly prone to defective night vision. The correlation between scores on the Hexagon test and age, for the total neurotic group, was -0.394 , thus confirming the findings of Harman (119), Rycroft (247), and Lister and Bishop (180). The only significant difference in age between the three neurotic groups was that between the depressives and hysterics,

the former group being somewhat older than the latter. The correlation between night vision and intelligence, as measured by Progressive Matrices (1938), was $-.107$. A further interesting result from this investigation was that the Hexagon test differentiated not only between neurotics and normals, but also between the more seriously ill and the less seriously ill.

In a comparative study of four screening tests for neurotics in which a body-sway test of suggestibility, the Ranking Rorschach, the Maudsley Medical Questionnaire, and the Hexagon night vision test were used, Eysenck (80) has shown that the dark vision test was most discriminative as determined by Eysenck's Index of Screening Efficiency (80, p. 252), and also by the Selection Index proposed by Hunt *et al.* (133).

Himmelweit *et al.* (122) gave 13 tests, including a test of dark vision, to a group of 105 male service patients in an investigation of neuroticism by means of factor analysis. These patients were all returned prisoners of war who had been referred for psychiatric treatment. A control group was provided by 93 surgical cases (also returned prisoners of war), who were matched with regard to age and educational background with the experimental group. The apparatus used for the Dark Vision test was the U.S. Radium Plaque Adaptometer, and the conditions of testing were similar to those adopted in administering the Livingston Hexagon test. Following 30 minutes' dark adaptation, detailed instructions were given to the subject in a 10-minute period spent in the dark room. The subject was required to give the direction (right, left, up or down) of the letter T which appeared on a uniformly illuminated background. The position of the letter was changed 20 times in a pre-arranged random order, and one point was allotted for each position correctly described. A fixation point was provided by a faintly illuminated red cross just above the disc on which the T was shown, so that the retinal image of the letter fell outside the fovea. Intercorrelations were calculated between 17 scores from the various tests in the battery and the resulting matrix was factorized to give two factors, the first of which was identified as neuroticism while the second appeared to be a factor of introversion-extraversion. Each test score was also correlated with the psychiatric diagnosis, which served as an external criterion. It was found that the dark vision test correlated to the extent of $.25$ with the first factor, $.28$ with the second factor, and $.27$ with the psychiatric diagnosis.

In an investigation of the dark vision of normal and neurotic army personnel, Gravely (109) departed from the usual procedure of measuring sensitivity after 30 minutes' dark adaptation by taking threshold measurements during the first ten minutes in the dark, following the suggestion of Wittkower *et al.* (316) that different levels of adaptation might be used as criteria of night visual capacity. The apparatus used for the experiment was an Admiralty Research Laboratory Adaptometer, Mark 1a, which covers a wide range of illumination from 3.961×10^{-7} eq. foot candles to 7.847×10^{-3} eq. foot candles by means of a specially calibrated lamp used in conjunction with three filters and 16 graded apertures. The subject is required to determine the position of a sector which can be rotated into eight different positions against a circular viewing screen, the brightness of which can be varied. In the test procedure adopted by Gravely the brightness of the screen was first set at 10.37×10^{-4} eq. foot candles so that all subjects could give a correct answer. The illumination was then decreased by two apertures, the sector rotated to a new position, and the subject's second response recorded. This procedure was continued until the subject took 30 seconds or longer to respond, or until he was making frequent errors; the illumination was then decreased by single apertures. Readings were taken in terms of filter and aperture after 3, 6 and 10 minutes in the dark. No fixation point was provided, but the subject was encouraged to use peripheral vision when he experienced difficulty in locating the position of the sector.

The test was given to an experimental group of 62 neurotics, including 31 anxiety states and 31 hysterics, and to a control group of 94 normal subjects. Significant differences were found between the scores of neurotics and normals at three minutes, six minutes, and ten minutes but, contrary to previous findings, no significant differences were found between the anxiety states and hysterics. A particularly interesting result was that the significance of the difference between the mean scores for the controls and the neurotics increased with the length of time in the dark.

In view of the results reported in this section, it appears that dark vision may

provide a fairly effective means of assessing both conative and affective factors in personality. Complete agreement between the findings of different investigators cannot be expected at this stage, owing to the use of different types of adaptometer, experimental procedures, populations, and so on, but the agreement is sufficiently striking to provide a basis for further investigation.

One of the most urgent requirements in this field is for some hypothesis concerning underlying mechanisms. Such a hypothesis might be based, following the work of Kekcheyev (153) and Babskii (7), on autonomic influence. This would tie in well with the writer's suggestion, put forward elsewhere in this paper (p. 21), that accommodative factors probably play an important part in determining responses to some of the usual adaptometer tests.

A second important requirement is that workers in this field should pay more attention to the control of objective factors which are known to influence dark adaptation, such as the immediate past history of the subject's retina before taking the test, the retinal region which is to be tested, and so on. Consideration of such factors and their systematic manipulation in accordance with an explicitly stated hypothesis should result in a clearer definition of the visual characteristics in terms of which personality differences are revealed.

Linked with this problem is the further question of the choice of apparatus from among the many different types of adaptometer that are available. As Michaelson (212) has pointed out, while some adaptometers measure only the subject's "minimum form sense," others measure, in addition, his "minimum light sense." Here again choice should preferably be made in accordance with a definite hypothesis.

It would also be desirable to explore other aspects of scotopic vision in addition to those investigated by means of the various adaptometers. For instance, it would be worth while, following the practice of Livingston (181), to apply a perimetric test, especially as he reports a circular field contraction which may have some diagnostic value in hysteria. Some of the differences between day and night vision that Wright (318) has mentioned could also be investigated in relation to personality differences. Thus, the sensitivity of the eye to brightness contrast is drastically reduced in scotopic vision; the visual acuity or resolving power of the eye is diminished; there is considerable deterioration of stereoscopic acuity and loss of space perception, a reduced discrimination between textures, and an impaired judgment of movement.

(b) *Colour vision.*—Several studies have been undertaken in which the incidence of defective colour vision in various psychiatric groups has been compared with that of the normal population. The first investigation in this field was carried out by Hrdlicka (128), who found the prevalence of colour defect in a large group of psychotics was no greater than in the population at large. Dunlap (67), in a small-scale study, gave the Ishihara and a revised version of the Nela test to 12 mal-adjusted individuals (mainly neurotics) and found defective colour vision in 11 cases. Millard and Shakow (213) administered the Ishihara test to 839 psychotic patients, but found no significant deviation in the incidence of colour blindness from that of a normal population. Kaplan and Lynch (147) used the Ishihara test in conjunction with a few Stilling type (pseudo-isochromatic, American Optical Company) charts in order to estimate the presence and degree of colour defect in a group of 403 adult psychotics (including 371 schizophrenics and 32 manic-depressive patients); results showed a greater incidence of defective colour vision in the psychotic group than in the normal adult population. The results of this study have recently been criticized by Hardy, Rand, and Rittler (117, 118) as being based on faulty testing charts, ignorance of random errors made by psychotics, and inadequate criteria of colour defect. In their own investigation, in which the Ishihara and American Optical Company charts were administered under well-controlled conditions to 123 male and 112 female psychotics, results showed no significant deviations from the normal population.

Finally, brief reference may be made to Jaensch's work on differences in the colour discrimination of his integrate and disintegrate types. Results obtained in a colour-matching experiment (138) suggest that integrated individuals tend to show greater discrimination for colours of long wavelength than disintegrates.

Before making any final pronouncement as to the incidence of defective colour vision in various psychiatric groups, it would be advisable to undertake more extensive studies on the different neurotic and psychotic sub-categories, for the data so far relate only to the conative dimensions of personality. In view of the

claim often made in the literature that colour is in some way associated with affectivity, it may be possible to set up specific hypotheses concerning the particular aspects of colour vision that are assumed to have diagnostic value. Certainly the field should be explored in greater detail if only to attempt some explanation of the apparently contradictory findings that have already been obtained.

(c) *Visual acuity*.—In the introduction to his *Factorial Study of Perception*, in which he attempts to isolate fundamental factors of personality by means of a battery of perceptual tests, Thurstone makes the following remark about tests of visual acuity: "We have avoided those measurements that seemed likely to be restricted in significance, such as visual acuity, and we have preferred those which might reflect some parameter of more central significance or association" (281, p. 2). This rejection of acuity measurements does not seem justified in view of available facts in this field. In the first place, central factors or parameters that Thurstone would measure are known to operate in visual acuity (66), and secondly, a number of studies suggest that some of these factors may be of the non-cognitive kind in which Thurstone is particularly interested. Some of these studies will be briefly reviewed.

Michaelson (211) has found that defective visual acuity tends to be a common functional symptom, which may vary from almost complete amaurosis of one or both eyes to a reduced acuity of between $\frac{3}{4}$ and $\frac{3}{8}$. Two types of test are mentioned as being of value in the detection of this functional defect. The first depends upon the fact that the visual fields for white targets of different sizes have a definite relationship to each other and also to fields for coloured targets. In functional cases this normal relationship is upset. The second test depends on the correlation which exists between visual acuity, as determined by the number of lines that can be read on a Snellen chart, and the distance of the chart from the subject's eyes. In Michaelson's procedure acuity is taken at six to eight different distances from the chart, starting at the furthest one, and varying the order in which acuity is taken at the different distances. A graph is then plotted with distance as abscissa and Snellen acuity as ordinate. In normal cases this relationship is found to be linear, whereas in functional cases there appears to be a significant departure from linearity.

In a well-controlled experimental study E. and P. Slater (267) have shown that neurotics tend to be inferior in respect of visual acuity to a group of normal controls of the same age, intelligence and status, while amblyopia with an hysterical basis has been reported by Halpern (115) and Yasuna (319). This type of amblyopia tends to be bilateral and often associated with other symptoms complained of by neurotics, such as photophobia, blurred vision, spots before the eyes, etc. Extreme forms of visual inhibition resulting in an almost complete loss of form vision have been reported by Redslob and Brini (235), Pinho (225), Bailliart (9), Mahoney and Linhart (206), Halpern (115), Yasuna (319), Traquair (284), Berger (20) and others. That suppression or inhibition amounting to an almost complete loss of acuity is dependent on some sort of functional disturbance in the nervous system is indicated by the experiments of Janet (141, 142), McDougall (202) and Lundholm (197, 198), who had some success in producing partial amaurosis by means of hypnotic suggestion.

These studies may be considered in relation to the work of Vogt (291), and Wald and Burian (297), which seems to indicate that the site of the suppressor mechanism operating in the types of visual inhibition that have been discussed is at the cortical level. In amblyopic vision it appears that a functional separation is effected between the more primitive light sense and the more lately evolved form sense. The whole concept of "visual inhibition" and all that it implies would seem to be a fertile one for further development in relation to personality study.

(d) *Visual fields*.—One of the first writers to realize the possible significance of visual field characteristics for personality study was Charcot (43), who drew attention to the contraction of the visual fields in hysteria: this particular symptom he regarded as one of the essential "stigmata" of that condition. Later writers, in particular Babinski (6), failed to confirm this view when non-suggestive methods of perimetry were used. However, many other writers have provided evidence which suggests that a significant relationship may exist between hysteria and field contraction. Thus, Eszenyi (73), in an investigation of 200 hysterics, found only three with normal visual fields, the most frequently occurring deviation being concentric contraction resulting in a tubular field. In this respect Eszenyi's results

tend to support earlier findings by Charcot (43) and Bleuler (27). Several writers, including those already mentioned, and Yasuna (319) and Eames (69), have noted sharp edges in the typical field of hysterics, together with circular limits; apparently the size of the test object has little influence in the limiting isopter. The particular characteristic of the field limits in functional cases which seems to differentiate them from organic cases of constriction is that they are cylindrical or tubular rather than cone-shaped; this feature is regarded by such writers as Parinaud (222) and Wilbrand and Saenger (313) as analogous to certain cases of anaesthesia, and may be compared with a phenomenon described by Duke-Elder (66) as "visual extinction," or relative hemianopia. Other writers who have linked the phenomenon of tubular fields with hysteria are Ford (91), May (209), Tassman (278), and Halpern (115).

An interesting finding is that even though the fields may be extremely contracted, central vision may in many cases be good; on the other hand, Traquair (284) reports that in some cases any degree of amblyopia may be present. In regard to the extent of the contraction, this is usually considerable, and may in extreme cases produce a field of only 10° to 30° .

Another significant feature of the visual fields in hysteria is an inversion of the normal colour fields; this was found in 66 out of 200 hysterics studied by Eszenyi (73). The typical characteristic appears to be an inversion of the fields for red and blue (231), while contraction of the colour fields culminating in colour amblyopia tends to occur in the order: purple, green, blue, and red (73, 222); this order appears to differentiate functional from organic cases, where the red field is affected first instead of last.

Turning next to field characteristics in anxiety states and neurasthenia, these are, according to Traquair (284), characterized by exhaustion and general instability. At the outset of the perimetric examination the field appears slightly contracted and, as the test proceeds, it tends to shrink further. If the examination is started once again with a larger test-object the field may be somewhat wider to begin with, but soon contracts again (284), so that, if the test object is moved radially and centripetally along successive meridians, until a constant reading is obtained for each meridian, a spiral field is produced with an inward or contracting spiral, ending in a small central field.

A star-like figure may be produced if first the two opposite ends of the vertical and horizontal meridians are tested, and then the two ends of the 45° and 135° meridians, the eight resulting points being joined. Traquair (284) reports that a characteristic finding is that when one field has been tested to the limit of reduction, the field of the other eye will be found to be already contracted.

Linked with these phenomena are a further group which have been termed by perimetrists, "exhaustion" and "oscillating" fields; the latter are characterized by the successive disappearance and reappearance of the test-object along different meridians. An extreme form of this phenomenon is known as multiple concentric ring scotomata; Traquair compares this to a "stammering of perception," and he notes that it always occurs near the periphery of the field and never in the centre.

Fuchs (97, 98), Hurst and Symms (134) and von Reuss (238) claim to have demonstrated spiral fields of a contrary type, i.e., expanding rather than contracting; the last-mentioned writer found white test-objects were more effective in eliciting such spirals than were coloured objects. These data, taken in conjunction with the fact, noted earlier, that testing one field causes contraction of the field of the other eye, suggest that these phenomena have a central rather than a retinal origin, which may point to their dependence on personality characteristics of a fairly fundamental type.

Also relevant to this section is a small-scale study by Baird (10), in which he found a diminution in the colour zones of neurasthenic patients, as compared with normal controls, and Reeder's (236) more recent investigation in which changes were found both in the extent and form of colour fields in subjects suffering from psychogenic disorders.

It appears from this review that perimetric tests, which have long been recognized as having diagnostic value in neurology, may also prove to be of value in the diagnosis of functional disorders and in personality study, but owing to the absence of any systematic experimental studies in this field no definite conclusions can as yet be drawn.

(e) *Flicker-fusion*.—Critical flicker frequency (c.f.f.) is dependent on a number

of stimulus conditions, organic factors, age, and many other variables, but several studies suggest that it may also be of some value in personality study. One of the first authors to use c.f.f. for this purpose was Wiersma (312), who studied the c.f.f.s of nine normal subjects, 11 manic-depressives, and 18 melancholic patients, by means of a rotating red-green colour disc. Results showed that the average value of the c.f.f. (measured in revolutions per second) was 15.7 for the normals, 27.2 for the manic-depressives, and 12.2 for the melancholics. It was also found that the manic-depressive patients tended to have high thresholds when in the manic state, low thresholds in the depressive state, and intermediate thresholds after they had made a satisfactory recovery. The author interpreted his results in terms of the concept of *perseveration*, claiming that they were consistent with the varying degrees of ideational perseveration in the three groups studied. The experiment was repeated by Wynn Jones (145, 146), who found no significant differences between his normal, manic, and melancholic groups: the discrepancy between his own results and those of Wiersma he explained as being due to differences in psychiatric criteria. Further studies of c.f.f. as a measure of perseveration have been undertaken by Biesheuvel (23), who used an improved method of determining the threshold value, and by Lankes (171) and Shen (261), who found some positive correlation between flicker-fusion and other tests of perseveration.

Several investigations have been reported in which the c.f.f. has been used as a measure of temperament. Thus, Washburn *et al.* (303) found that extraverts tended to have a lower threshold than introverts, while Janzen (143) was able to differentiate between Jaensch's types on the basis of their threshold variability. He found that Jaensch's J_3 -type gave the most constant threshold values, the J_1S_1 -type was the most variable, and the J_2 -type assumed a median position.

Krugman (168), in one of the most systematic studies yet reported, attempted to differentiate between a group of 50 normal subjects and 50 anxiety states by means of their c.f.f.s. The apparatus used for his experiment was a General Radio Company "Stroboscotac," with a variable oscillating light covering a range of 600-14,500 c.p.m. After a period of light-adaptation to a standard source the subject viewed a 5° test-patch binocularly. For half the subjects in each group the average c.f.f. was determined, starting from a frequency of 3,700 flashes per minute and gradually diminishing the frequency until flicker was reported, while for the other half an initial frequency of 2,000 per minute was gradually increased until fusion was reported. Krugman found that the anxiety neurotics had a considerably higher threshold than the normals: the biserial correlation between flicker threshold and psychiatric diagnosis was .45, when thresholds were measured from flicker to fusion, and .62 when they were measured from fusion to flicker.

Ricciuti (239) has examined the c.f.f.s in schizophrenics, manics, depressives, neurotics and normals in an attempt first to differentiate between the various groups, and secondly to test Wiersma's hypothesis (312) that manics show the greatest while depressives show the least perseveration, as measured by c.f.f. His subjects included 42 neurotics, 46 schizophrenics, 15 manics, 13 depressives and 54 normals. The c.f.f. was determined by means of an electronic flicker apparatus, and monocular viewing was employed. Of the differences in mean c.f.f. between the various groups studied, only that between the normals and the manics reached significance at the 5 per cent. level, although the normals had a somewhat higher c.f.f. than each of the abnormal groups.

Gravely (109) has investigated the flicker threshold in 100 normal subjects, 28 anxiety states, and 28 hysterics, using a Dawe Strobflash (Type 1200c), with a frequency range of 600-14,500 flashes per minute (i.e., the same range as in Krugman's experiment). The test patch was viewed binocularly in a dark room, after a period of ten minutes' dark adaptation, and thresholds were taken in ascending and descending series, from an initial setting of 2,000 flashes per minute; the score was the average of five ascending and five descending trials. None of the differences between the groups was significant, but the normal subjects had a higher average threshold than the neurotics, and the hysterics had a higher threshold than the anxiety states.

The results reported in this section present rather a confused picture. Thus, Krugman (168) found a considerable difference between the c.f.f.s of anxiety states and normals, but Gravely (109) and Ricciuti (239) failed to find any marked difference; Wynn Jones (145, 146) and Ricciuti (239) failed to confirm Wiersma's findings on normals, manics and melancholics. These discrepancies may not be

fundamental, owing to differences in experimental procedure between the various investigations. For instance, Krugman took threshold measurements after a period of light-adaptation, whereas Gravely's readings were taken after a period of dark adaptation; both Krugman and Gravely used binocular stimulation, while Ricciuti used monocular stimulation. These, and other differences in technique, make comparison difficult.

(f) *Autokinetic movement*.—The autokinetic phenomenon is a form of apparent movement which occurs when a small light source is fixated by an observer in an otherwise completely dark field. First reported by von Humboldt (131) in 1790, and later referred to as Charpentier's illusion (45), it was given its present name by Aubert. A concise history of the autokinetic effect as a scientific problem has been given by Adams (1) and Hovland (127). Several theories have been offered in explanation of the phenomenon, based on eye-movements (126, 266), the so-called "streaming phenomenon" (89, 111), and central factors (51), but none is entirely satisfactory.

The pattern of movement appears to be influenced by a number of factors, both objective and subjective. Thus, it is diminished by increasing the size (148, 181) or brightness (181) of the light source, or by introducing accessory lights into the visual field (181); it is influenced by the background (181) and varies with the area of the retina which is stimulated; it is also influenced by the subject's mental set (114) and by social factors (262). Sherif (262) has made use of this fact in his well-known experiments on the development of social norms, recently extended by Schonbar (256) and Bovard (30). These studies are cited by Eysenck (82) as bearing a close relationship to researches on suggestibility.

Voth (294) has shown, in a study of the autokinetic reactions of 600 subjects, that there are marked individual differences both in the amount and direction of movement, which makes the phenomenon of particular interest in personality study. His experimental procedure was to ask the subject to record on a rectangular graphboard the movement perceived while viewing a small light source (1 mm. in diameter) at a distance of 10–12 feet, for a test period of ten minutes in a dark room. If the light stopped moving the subject was asked to make a heavy dot on the paper and to continue from that point when movement started again; if the subject found he had reached the edge of the board, he was instructed to return to the (estimated) centre.

Voth computed an autokinetic index for each subject by combining four measures in an empirical formula; these were: total length of path, maximum distance attained from the centre, maximum expanse of the graph, and number of stops. Reliability on re-test proved to be as high as .96 for individual subjects.

In another investigation (295) the same author found autokinetic patterns characteristic of normal subjects and various psychiatric groups. Whereas movement was pronounced in schizophrenics, psychasthenics, neurasthenics, and anxiety states, it was either absent altogether or greatly reduced in manic-depressive and involutional psychotics and in cases of conversion hysteria. Age differences appeared to exert no significant influence on the effect within the different groups studied, but there was a significant sex difference, men being on the average more susceptible to movement than women.

Sexton (258) undertook a similar investigation of 500 subjects, but using a somewhat different scoring technique. Instead of computing an autokinetic index as Voth had done, Sexton simply classified his subjects' graphs in terms of the amount of movement recorded on a circular graph-board of 60 cm. diameter. Each graph was divided into four sections by drawing concentric circles at radial distances of 5 cm., 10 cm., 20 cm. and 30 cm. from the centre of the graph, thus giving five scoring categories: no movement, a small amount of movement, a moderate amount, a large amount, and a maximum amount. On the basis of his results Sexton claims that the test provides an objective measure of introversion-extraversion, the amount of recorded movement bearing a direct relation to the degree of withdrawal from reality. Thus, patients of a schizoid type recorded more movement than the more extraverted individuals and, within the schizophrenic group itself, paranoids reported least movement, hebephrenics somewhat more, while catatonics reported maximum movement. Sexton corroborated Voth's findings concerning the high reliability of the test.

In an attempt to differentiate between groups of normal and neurotic subjects and, within the neurotic group itself, between anxiety states and hysterics, Gravely

(109) obtained autokinetic records from 146 army personnel. The light source for her test was 1 mm. in diameter, placed three feet above the subject's eye level, at a horizontal distance of seven feet from the subject. Measures were taken of autokinetic reaction time (i.e., the time taken for the subject spontaneously to report movement) and the amount of movement recorded during a period of three minutes, together with a measure of the influence of set or suggestion on the direction of movement. Records of movement were made on a square graph-board, in the centre of which was placed a luminous drawing-pin, so that the subject could find the centre of the graph without resorting to guessing, as in the researches of Voth (294, 295) and Sexton (258). No significant differences in autokinetic reactions were found either between neurotics and normals or between anxiety states and hysterics.

From the few researches that have been concerned with individual differences in autokinetic movement, it may be concluded that the phenomenon appears to be of some value in personality study. However, before the autokinetic affect can be made the basis of a satisfactory test of temperament it will be necessary to account for the apparent discrepancy between the results of Voth (295) and Sexton (258) on the one hand and of Gravely (109) on the other. It may be that the different results are due to differences in the experimental procedure (e.g., length of time for recording movement), or to different external criteria in the selection of subjects. It will also be advisable to experiment with different scoring measures. For instance, if the graphic method of recording movement is used, it might be worth while to devise some means of determining the scale adopted by the subject in representing the movement he perceives: as Thurstone (281) has pointed out, two subjects could perceive the same amount of movement and yet employ different subjective scales to record it.

It might even be desirable to eliminate the graphic method of recording altogether and, instead, to measure a person's susceptibility to autokinesis by manipulating some of the objective factors which are known to influence the effect. For instance, as the amount of movement is reduced to a minimum until it eventually disappears, by increasing the size of brightness of the light source, or by introducing accessory lights into the visual field (181), it should be possible to measure individual susceptibility to the effect by determining (a) the level of brightness at which movement ceases, (b) the size of light source which just fails to produce movement, and (c) the number of accessory lights which must be introduced before the subject no longer reports movement.

(g) *Pupillary reactions.*—The diagnostic value of pupillary reactions has long been recognized in ophthalmology and neurology and, in view of their sensitivity as an index of bodily disorder, there is some justification for regarding the pupils (following the great physiologist Schiff) as the finest aesthesiometer in the body. It would not be surprising, in view of the multiple connections of the pupillary pathways, if they were also found to be of considerable value for the study of personality and its functional disorders. Indeed, the largeness of the area which the pathways traverse, and their interconnection with many upper and lower parts of the brain, has led Behr (15) to contend that there is scarcely any nervous function which has no effect, direct or indirect, on pupillary behaviour.

Pre-eminent in this field is the work of Lowenstein (185-192), who is responsible for the development of the technique of pupillography, in which cinematographic records are taken, using a non-stimulating infra-red light. This technique allows, for all practical purposes, a condition of physiological darkness, so that pupillary behaviour may be observed both in darkness and in light. By this means it is possible to analyse both contraction and dilation of the pupil into definite stages, and to differentiate the parasympathetic and sympathetic components in the records.

As a result of this technique, Lowenstein and Levine (194) have succeeded in analysing pupillary reactions to light into four groups. The first type is characterized by rapid contraction, and rapid dilation; the second, and most common type, involves a prompt contraction and a sluggish dilation; the third type is characterized by a sluggish contraction and a prompt dilation, while the fourth type consists of a sluggish contraction and a sluggish dilation. These four types represent, according to the authors, four kinds of equilibrium between the parasympathetic and sympathetic. The reactions are apparently constitutionally conditioned. Of particular interest to this paper is the significant relationship which appears to exist between the first type of reaction and manic-depressive psychosis and between

the type 4 reaction and schizophrenia. In an earlier paper Lowenstein and Westphal (195) found the type 4 reaction to light was, in schizophrenics, often transformed into a fifth type, with a relatively long latency period, marked sluggishness, mild contraction, and a very sluggish re-dilation. In catatonics yet another type of reaction was found; this was characterized by a long latency period, a rapid reaction to light, and a long latency period for the re-dilation, followed by a full dilation. Lowenstein considers that a special type of permanently heightened tonus is responsible for these reactions, which he terms "tonohaptic." Such reactions also tend to occur in patients suffering from obsessions and phobias (189, 190).

Lowenstein and Friedman (193) mention another unusual pupillary reaction to light, known as the "cog-wheel pupil," where contraction, but more frequently re-dilation, occurs in a series of steps instead of in a single sweeping movement; this tends to be associated with hysteria and, like the other reactions already mentioned, appears to be constitutionally conditioned.

Turning next to the conditions known as mydriasis and miosis, in which the pupillary diameter shows static deviations from the average values of between about 2.5 mm. and 4 mm. (66), these also appear to have some connection with personality factors. Thus DeJong (57) claims that, "In the so-called vagotonic individuals with cold skin, bradycardia, and low blood-pressure, the pupils are contracted owing to overaction of the parasympathetic nervous system," while "in the sympathicotonic individual with warm skin, rapid pulse, and hypertension, there is mydriasis" (57, p. 161). (DeJong places anxiety states and some schizophrenics in this second group.)

Westphal (309, 310) observed a phenomenon in catatonic patients in which the pupil is usually in a condition of mid-dilation or transient mydriasis, with a variable response to light, ranging from a prompt reaction to absolute rigidity; the anomaly was also found in traumatic neurosis. The variability of the phenomenon both in regard to responses to light and in respect of size and equality led Kehrer (152) to call it "spasmus mobilis." Koester (163) has observed the condition in 34 per cent. of the catatonic patients he examined over a long period; Menninger (210a) found a similar anomaly in the pupillary reaction to light in 25 per cent. of schizophrenics, and the phenomenon has since been noted by Levine and Schilder (174), who, on the basis of a series of experimental studies, advance the theory that the "catatonic pupil" is due to an imbalance of the sympathetic-parasympathetic system as a result of inhibition of the parasympathetic division.

Linked with these studies is a recent research by May (210), in which abnormalities were found in the pupillary reaction to light of a group of 343 schizophrenics as compared with 100 normal controls. The author found a connection between these disturbances and the pupillary changes that occur during muscular effort, and which are attributed to simultaneous sympathetic stimulation and parasympathetic inhibition by motor impulses having their origin in the hypothalamus. From a psychobiological viewpoint May considers that the anomalies in the pupillary reflex to light, like those resulting from pain stimuli and muscular effort, can be linked with the general hypoactivity which schizophrenics show to a variety of stimuli, and their lack of normal physical and emotional response to the environment.

A condition known as "spastic mydriasis" in which a dilated pupil is associated with marked pupillary unrest and increased pupillary reflexes has been distinguished by Behr (15) and appears to be linked with functional disorders. Thus, Hübner (130), Koester (163), Pickert (224) and Feinstein (86) have all noted its occurrence in schizophrenics.

Duke-Elder (66) notes that miosis can occur as a result of autonomic imbalance resulting from a release of the normal inhibitory activity of the sympathetic system over the constrictor centre of the hypothalamus. It can occur in schizophrenia, and may also appear in hysterics, associated with spasm of convergence.

In connection with studies of mydriasis and miosis, it is also relevant to refer to the condition known as anisocoria, in which there exists an inequality in the size of the pupils in the two eyes. DeJong (57) considers that a slight difference here may be found in neurotics and psychotics, although this would not be easy to prove in view of the very strict standards of illumination and testing conditions that are required, and the association of the phenomenon with numerous other factors.

DeJong (57) makes a further claim to the effect that a hippus pupil may indicate poorly balanced or integrated sympathetic and parasympathetic divisions of the autonomic nervous system. This periodic phenomenon is characterized by rhythmic but irregular oscillations of a deliberate temporal pattern, and of considerable excursion (2 mm. or more); it is known to occur, not only in many pathological states, but also in conditions of psychological instability (66).

A recent investigator of "autonomic imbalance," Wenger (306), included a pupillary test in a battery of tests purporting to measure an autonomic factor, but the results he obtained were most disappointing. He found very low correlations between this test and others in the battery. In view of the importance of Wenger's study in connection with the factor of neuroticism (80) and the theoretical considerations of parasympathetic and sympathetic innervation which led him to include this test in his battery it will be described in some detail, for the structure of the test may suggest a reason for the disappointing results which he obtained.

The diameter of the pupil was measured by means of a card 5 in. by 8 in. on which were drawn a pair of converging lines with the point of greatest divergence, approximately 20 mm., at the lower part of the card. Pairs of pinpoint holes were drilled at intervals along the converging lines in such a way that the centre-to-centre distance between any pair increased in steps of .5 mm.; the effective range was about 2.5 to 8.0 mm. The subject was instructed to hold the card in front of one eye with the other eye covered, and to look through different pairs of holes on the card at some object more than 30 ft. distant.

Three possible types of pattern could then be seen, depending on the subject's pupil size: (1) The images would appear to overlap; (2) the image would consist of two disparate circles of light; and (3) the circles of light would appear to be tangent. These perceptions correspond to (1) the condition where the centre-to-centre distance of a pair of holes is smaller than the subject's pupillary diameter; (2) the condition where the distance is greater than the subject's pupillary diameter; and (3) the condition where the distance between centres equals the subject's pupillary diameter.

As the surface of the card was dull black and only a relatively small amount of light could enter the pupil through the pinpoint holes, the eye in use could be regarded as being in a state of relative dark adaptation. Wenger found that variations in light in the experimental room and in the external environment appeared to have no significant effect on the results. When the subject had found the pair of holes which were just tangent the greater part of the time during fixation, the experimenter read the pupillary diameter from the opposite side of the card.

Several reasons immediately suggest themselves in explanation of Wenger's results. Firstly, the technique is a relatively crude one, in relation to the sort of subtle changes that Lowenstein's work suggests it may be necessary to detect. Secondly, although Wenger included the test of pupillary diameter on the basis of theoretical considerations concerning autonomic activity, these were of a very general type, whereas it would seem necessary to consider in more detail the particular aspects of pupillary behaviour that are likely to be most diagnostic of autonomic imbalance, on the basis of more specific hypotheses; the fairly static type of record which Wenger obtained may not be the most appropriate for his purpose, even if a more precise measuring instrument were used. Finally, it appears necessary to take into account the effect of the many factors which are known to influence mydriasis and miosis, such as sex, age, eye colour, and refractive errors (66), to mention only some of the more obvious variables. It seems likely that significant personality correlates will be found only if great care is taken in the experimental set-up, along the lines of Lowenstein's work. Certainly Wenger's results should not be regarded as closing this chapter of research which, on the basis of some of the known mechanisms of pupillary behaviour and clinical observations and experiments such as have been reviewed in this section, appears to be a profitable one for personality study.

(h) *Ocular movements.*—The mechanism of muscle balance in vision involves the co-ordination of at least twelve delicate ocular muscles, and it would not be surprising if such a highly-coordinated mechanism were readily put out of gear by general functional disturbances. In fact, the available evidence does suggest that heterophorias, anomalies in the vergence functions and other anomalies of ocular movement may in many cases have a definite psychological basis. The influence

of psychological factors is emphasized both in standard text-books of ophthalmology (66) and in manuals on orthoptics (101, 201).

This influence was shown convincingly in the second world war among air-crews undergoing orthoptic treatment for heterophoria. In a typical study of such subjects Gillespie (102) found that, out of 60 cases, 40 showed the same sort of characteristics as were found in air-crews breaking down with frank neurotic symptoms. This high percentage led the author to suggest that the reason why these individuals suffered from their ocular disability was that the latent imbalance was made manifest by their pathological emotional state: the emotional disturbance was sufficient either to cause an upset of the compensatory muscular effort made to overcome an innate heterophoria or, alternatively, caused fatigue in the muscular apparatus, resulting in a greater effort of compensation. In other words, Gillespie suggests that fatigue is intermediary between the emotional state (here anxiety) and the ocular symptoms, and this suggestion was confirmed, so Gillespie claims, by the fact that a number of his cases were of an obsessional temperament, which "... is particularly apt to favour the appearance of fatigue in its possessor."

Ironside and Batchelor (136), though not subscribing to the view that all heterophorias have a psychological basis, have also found evidence in a small experimental study of a correlation between muscle imbalance and neurotic constitution. Doggart (63) considers on the basis of his observations that heterophoria is a very common manifestation of neurosis, and goes so far as to say that "... disturbances of muscle balance are so frequently psychological in origin that many symptoms attributed to them are in reality due to the central sensory disorder—whatever its nature may be—that constitutes the psychoneurosis" (63, p. 32). This author regards the dynamic vergence-power as of greater significance than the static muscle balance, as measured by the ordinary tests of heterophoria: the depletion of duction-reserve may be one aspect of a lowered muscular tone associated with the neurosis. He cites convergence-defect as being a characteristic functional disturbance. An observation of Doggart's which may prove useful for personality measurement is that a marked discrepancy between the degree of heterophoria as measured by the Maddox rod and the Bishop Harman tests is indicative of neurotic tendencies.

In addition to deficiency in the positive fusional reserves, such as Doggart has mentioned, convergence excess, amounting in many cases to a spasm of convergence, also appears to be linked with neuroticism in certain cases. Thus Souders (270), Cords (49) and others have observed this condition in hysterics, associated with miosis and accommodative spasm. One of the mechanisms at work here may be removal of inhibition of the convergence innervation, as in the esophoria produced in normal subjects under the influence of alcohol (2, 48, 230) or under conditions of severe anoxaemia (2, 289); these facts may be of considerable importance in the experimental development of this field.

Also relevant to this section are experimental studies of eye movements in psychiatric subjects. Thus, Dodge and Diefendorf (62) examined the "angular velocity" and certain characteristics of the pursuit reaction in the ocular reactions of psychotic patients. Their technique involved the recording of eye movements on a moving photographic film with a mirror-recorder actuated by the corneal protuberance. It was found that the angular velocity for a visual angle of 25° suffered little in most of the psychotics, but was reduced for depressed patients. Greater deviations appeared in pursuit reactions: the records for depressed patients showed long sweeps which frequently passed the point to be fixated, while the schizophrenics made short, step-like movements.

Couch and Fox (50) made a similar photographic study in which they investigated the ocular pursuit of a pendulum, optic nystagmus, response to commands to look right and left, and response to peripheral stimuli in 117 patients and 16 normal controls. The records of 60 of the patients were normal apart from minor deviations due to "lapses of attention," but short, step-like interruptions of pursuit movements, considered characteristic of schizophrenics by Dodge and Diefendorf, appeared in the records of 41 patients of varying diagnosis. Eighteen of the most disordered patients (five in catatonic stupor) showed profound disturbances of ocular adjustment in both phases, with extreme variability in their records. An interesting observation was that the records of three catatonics showed their eyes moving in a direction opposite to that of the pendulum; the authors offered a

tentative interpretation in terms of the negativism supposed to characterize such patients.

White (311) studied ocular pursuit movements in 20 normals, 17 schizophrenics, 8 manic-depressives and 13 neurotic patients by means of a photographic technique. Records were taken of the eye-movements elicited by 10 oscillations of a pursuit object at each of ten velocities; this object consisted of the light from a flashlight bulb made to pass through 9° of the visual field. The author found no pattern of ocular adjustment among the patients which was not also found in the normal group. Contrary to previous findings, neither negativism nor step-like movements were found to have any diagnostic significance. Differences between the normal and psychiatric groups did appear, however, in the greater irregularity and earlier abandonment of pursuit in the latter.

Various types of nystagmus seem to have an association with emotional factors in personality. Thus, deviational nystagmus, which occurs after a latent period of 30 seconds in about 50 per cent. of normal subjects when the fixation axes are deviated beyond the limits of the binocular field and an attempt is made to keep them there, occurs occasionally in psychiatric states without the usual latency period according to Uffenorde (287) and Kestenbaum (155). Nystagmus of neurotic origin is mentioned as occurring in hysteria and in acute anxiety neurosis; this condition displays the normal features of voluntary nystagmus, but the pendular oscillations tend to be quicker (up to 1,200 a minute), and is associated with blepharospasm, convergence spasm and miosis (29, 88, 151). This rate is seen elsewhere only in miners' nystagmus, where the neurotic component also tends to be prominent in many cases (38, 39, 272). Other types of nystagmus with a functional origin have been described by Majewski (207) and Stransky (276).

A further study which indicates the relationship between eye movements and emotional factors is that of Ort (221), in which eye movements were recorded during the administration of a word-association test, containing loaded and non-loaded words, to a group of 32 subjects. It was found that loaded words were accompanied by eye reactions in about 80 per cent. of the cases, and the authors suggested that such involuntary eye movements might serve as a more sensitive indicator of emotion than any of the ordinarily-used complex indicators. Finally, mention may be made of an investigation by Lord (183), in which she found an enhancement of chronic nystagmus in a subject during a period of emotional disturbance.

(i) *Accommodation*.—It has for long been known that the mechanism of accommodation is dependent on the parasympathetic system, which causes contraction of the circular fibres of the ciliary muscle, but it has recently become more and more apparent that, while the parasympathetic may be primarily responsible for accommodation for near vision, an active accommodation for distant vision may be mediated by a contraction of the meridional fibres of the ciliary muscle, through sympathetic activity. Indeed, the present view seems to be that accommodation displays the typical antagonistic activity of parasympathetic and sympathetic divisions, which is found in other bodily systems subject to autonomic innervation. Probably the sympathetic role is inhibitory in accommodation for near, and active in accommodation for distance (66). This reciprocal innervation and mutually antagonistic activity by the two systems leads one to suppose that the mechanism of accommodation should provide valuable information concerning autonomic balance and imbalance and, via this trait, should increase our understanding of the factor of neuroticism. The available data, scanty though they are, do tend to support this view.

One of the most dramatic manifestations of the influence of personality factors in accommodation is in the ocular anomaly known as accommodative spasm. In this condition the tone of the ciliary muscle is increased, and a constant effort is required by the parasympathetic system so as to decrease the distance between the near-point and the far-point. This results in what has been termed a spurious or pseudo-myopia (175), in which the hyperope appears to become less ametropic, the normal emmetrope becomes myopic, and myopia is increased. The condition appears as an expression of excessive activity on the part of the parasympathetic nervous system, although hypoactivity in the sympathetic may also enter as a causal factor.

Two main categories of accommodative spasm may be distinguished, functional and organic, the former being of particular interest for personality study. Among the factors which determine its occurrence, the constitutional make-up of the

individual is mentioned as being of particular importance, those affected being typically of the neurotic type; this was demonstrated in the first world war when spasm of accommodation often appeared as a prominent feature of traumatic neurosis (66). Its most frequently reported personality correlate appears to be hysteria: the connection was first noted by Charcot and Galezowsky (44), and has been observed since by Borel (28), Morax (214), Plantegna (226), Shastid (259) and others, often in association with convergence spasm, myosis, contraction of the visual fields and amblyopia; this grouping may itself be of some significance as a personality syndrome or trait.

Other aspects of accommodation which appear to be of value for personality study are "insufficiency of accommodation" and "accommodative fatigue." In the former condition the accommodative power is constantly below the lower limit of what may be accepted as the normal variation for the subject's age, while the latter is characterized by the early onset of fatigue as defined and measured by the ophthalmic ergograph (18, 19); both conditions are mentioned as being related to neuroticism or other personality variables (66).

Owing to its significance as a basic ocular function, it is likely that the influence of accommodative disturbances will be shown in a number of perceptual tests used in personality study. To mention but one, the dark vision test, which is known to be a fairly good measure of neuroticism, may be affected by the inhibitory effect on accommodative activity that darkness is known to produce (149, 249).

(j) *Response time*.—One of the earliest studies of reaction time in relation to personality differences was reported by Obersteiner (217, 218), who found longer reaction times in psychotic patients than in normal persons. His results were later confirmed by Bevan-Lewis (21, 22), who also found that, among psychotics themselves, manic patients constituted the fastest group. Contrary to a generally accepted hypothesis of the day, the reaction times of manics were still appreciably longer than those of normal controls. Other early studies of a somewhat less systematic nature were carried out by Buccola (34, 35), Tschisch (285), Féré (87), Walitzky (298), Nadler (216), Toulouse and Vaschide (283), Richet (240), Raymond and Janet (233), and Pelletier (223), some of which may be of value to those who wish to experiment in this field.

Following these studies is an experiment by Franz (92), in which he measured simple and choice reaction times in a case of psychotic depression and found that his choice reactions were equal to or shorter than his simple reactions. The author considered that this anomaly might characterize depressives in general. When, however, he later undertook a similar experiment with six subjects (two manics, two depressives, and two controls), the exaggerated simple reaction times occurred in only one of the depressive patients, while the times for the manic and depressive patients were considerably longer than those of the slowest control.

Dodge and Diefendorf (62) investigated the ocular reaction times of psychotic patients to a peripheral stimulus, and found only a slight correspondence between the patient's condition and their reaction times, but the reaction times of depressives tended to be longer than those of schizophrenics and manics. Scripture (257), in an attempt to develop an objective means for diagnosing mental disorders, studied the reaction times of various clinical groups to a visual stimulus. His kymograph records yielded three measures: reaction time, variability of reaction time, and variability in "holding time," this latter depending on the way in which the subject pressed a manual response key. Several important differences were found between the groups tested: thus, hysterics tended to have extremely variable reaction times, and long "holding times" which, according to the author, exemplified their "mental inhibition," while depressive patients had considerably longer reaction times and "holding times" than any other group.

Wells and Sturgis (305) compared the choice reaction times of 12 schizophrenics with a group of normal subjects but found no evidence of any striking differences between them. The authors concluded (without justification) that their failure to find any pronounced differences indicated that the functions governing "vital adaptation" to life are dissociated from and independent of those governing the simple adaptations required in their laboratory tests. Wells and Kelly (304)

* Some of the studies referred to in this section deal with reaction-times to non-visual stimuli; it seemed advisable to include them, for they probably depend on the same factor, or closely related factors (281).

found the simple reaction times of 28 manic-depressive and schizophrenic patients were only slightly longer than for normals, thus failing to confirm the findings of earlier investigators; nor did the tendency for manics to have faster reaction times than depressives appear in the experiment. With regard to the variability of reaction times, this was greater in the manic-depressives than in the normal group, but the schizophrenics showed no deviation from the normals. Another measure, the ratio between visual and auditory reaction times, was found to be smaller for the schizophrenic group than for the manic-depressives or normals.

Lundholm (196) measured the reaction times of 12 manics, 2 schizophrenics and 2 controls twice weekly for several months, and compared the resulting distribution curves. He found that whereas the curves were "broad and loose" for the manics, they were "narrow and high" for the controls: the standard deviations of the times always increased as the patients passed into the manic state. There also appeared to be a relation between the amount of variability and the degree of the excitement. The authors concluded that variability of performance, considered as an index of the stability of attention, is the most significant symptom of disorder.

With an aim similar to that of Scripture (257), Saunders and Isaacs (250) found marked individual differences in the reaction times and variability both for normal subjects and 31 psychotic patients. Differences between the normal and psychotic groups as a whole and between the different psychotic groups themselves were barely significant. A tendency for the psychotic patients to give "anticipatory responses" was considered to have some diagnostic significance.

Huston, Shakow and Riggs (135) undertook several experiments on the reaction times of schizophrenic and normal subjects, in the first of which simple visual, auditory and visual discriminative reaction times were measured with a Cenco counter. One test was given to 25 normals and three tests were given to 38 male schizophrenic patients, and it was found that in general the patients showed slower and more variable reaction times than the normals. To account for these differences three hypotheses were put forward and tested in further experiments, in which the reaction times of 25 patients and 18 controls were measured in relation to an auditory stimulus. These experiments involved several different types of fore-period, and it was found that the schizophrenics were inferior to the normals in the height, regularity, and duration of the preparation for the reaction.

Rodnick and Shakow (244) used preparatory intervals of different lengths, with irregular warning procedures, to study differences between the set of normals and schizophrenic patients in a reaction time experiment. Results showed that the normals had significantly shorter reaction times than the patients, and shorter times with the regular than with the irregular procedures. On the other hand, the schizophrenics gave shorter reaction times with the shorter intervals in the regular procedure; at the longer intervals they gave shorter reaction times with irregular procedure. A composite reaction time index was computed which, the authors suggest, may have some practical value as a clinical device.

In an investigation of the speed and pattern of perception in schizophrenics and normal subjects, for simple letter combinations, Angyal (4) found, among other things, that the reaction times for the former group were greater than for the latter.

Other tests of response time that appear to be of promise for personality study are those involving judgments of a more complex type, such as have been used by Thurstone in his *Factorial Study of Perception* (281). In particular, Thurstone's speed of decision test, or some modification of it, seems to be of value. The original form of this test consists of a discrimination problem in which the subject is presented with pairs of circles and asked in each case to denote the larger. Some pairs of circles are of equal or nearly equal diameter, while others are of widely different diameter. The ratio of the mean response time for the easy discriminations to the mean response time for the difficult discriminations is taken as an index of the extent to which the subject tends to be retarded when asked to make a difficult judgment. Thurstone believed that this measure would be related to temperamental characteristics. In an improved form of the test no pairs of stimuli were included in which the items were exactly alike, and the use of circles as stimuli was discontinued; instead the subject was presented with pairs of squares filled with dots, and asked to judge which of the two squares contained the larger number. The squares contained from 50 to 200 dots so as to provide a wide range of difficulty. No temperamental correlates have yet been reported for the test, although research on the subject is in progress. Similar tests could be devised along the lines indicated

by Dashiell's (53), and Volkman, Hunt and McGourty's (293) researches on affective-distance as a determinant of response time in judgments of colour preference. Both studies have shown that the speed of judgment increases with the difference in affective-value between the colour stimuli. It might also be possible to make use of the relation which has been shown to exist between response time and the degree of subjective confidence with which subjects make various types of judgment (292) in the study of temperament or character.

A further result from Thurstone's *Factorial Study of Perception* (281) which is of interest to personality study is that reaction time and speed of perception appear as two different factors. Tests with the highest saturations on the first factor involved simple reaction times to light and to sound, while the tests defining the second factor were of a more complex nature: Peripheral Span (single and double), Dark Adaptation Time, Street Gestalt Completion, Social Judgment Time, etc. An incidental finding that may prove of interest in work on colour-form attitudes was that the Schmidt ratio test, a test of colour-form dominance, had a negative saturation ($-.29$) with the speed of perception factor, indicating that subjects who are form-dominant tend to have slower reaction times than those who are colour-dominant.

II. PERCEPTUAL ATTITUDES.

(a) *Colour-form attitudes*.—It has often been maintained, especially by writers on the Continent, that there are two basic attitudes in visual perception, one of which is characterized by colour-dominance and the other by form-dominance. Experimentation began comparatively early in this field with the pioneer research of Külpe (170), and was later extended to personality study by Scholl (254, 255), who suggested a connection between colour-form attitudes and Kretschmer's typology. He presented groups of similar figures in a tachistoscope to 30 subjects who were asked in each case to identify a coloured figure; identification could be either by colour or by form. When the subjects were classified as cyclothymes and schizothymes by means of a questionnaire he found a marked tendency for the former to be colour-reactive and the latter form-reactive. Scholl's results were later confirmed by Dambach (52) and Lutz (200), using similar experimental methods.

Ritter (242) investigated colour-form attitudes in children by means of Descoedres' test (60) and Scholl's sorting-box, and interpreted his results in terms of Jaensch's integrate and disintegrate types; the former tended to be colour-reactive while the latter were form-reactive. Braat (31) studied 27 schizophrenics and 10 manic-depressives by means of a tachistoscopic procedure, but failed to find any significant relationship between psychosis and colour-form reactions, as would be expected on the basis of Scholl's findings. Schmidt (252) used a very ingenious apparatus to investigate the relation between colour-form attitudes and typological diagnosis in 54 subjects. He projected coloured spots on a screen in such a way that apparent movement was seen in one of two directions, depending on the subject's spontaneous perception of either form or colour. Schmidt found agreement between typological diagnosis and colour-form attitude in 44 cases out of 54. Lüth (199) studied 156 subjects in terms of Kretschmer's typology, and found a high correlation between schizothymia and form-reaction, but a somewhat lower correlation between cyclothymia and colour-reaction. Other, small-scale studies, have been carried out by Poppinga (228), Oeser (219), Kibler (156), Enke (71, 72) and Tuompo (286), the results of which tend, in general, to confirm Scholl's hypothesis.

This hypothesis is also confirmed by Lindberg's very extensive study (177) of 424 adult psychotics, in which he found a highly significant difference between schizophrenics and manic-depressives in colour-form reactions, in the expected direction. Two tests were used in this investigation: a sorting-test, in which a set of cards could be sorted according to form or colour, and a new "Ring" test, devised by Lindberg himself. This consists of a coloured plate, divided into two parts both of which contain two figures—a circle with an arrow and a square with a smaller square inside it; the upper figures are blue in colour, while the lower ones are red. The subject is asked in what way the upper and lower figures differ. There are several differences between the two figures, such as the direction of the arrow, and the position of the circle. If the subject mentions the difference in colour in his first or second response he is regarded as having a positive attitude to colour;

if he mentions the colour difference later, or not at all, he is rated as having a negative attitude to colour.

A more recent investigation of colour-form attitude in psychotics was undertaken by Eysenck (84), who failed to find any significant differences between a group of 50 schizophrenics and 50 depressives on a colour-form sorting test; the test also failed to differentiate between the psychotic group as a whole and a control group of 100 normal subjects. There was, however, a significant difference between normals and psychotics in the time required to complete the test.

The work so far reported has been concerned primarily with measurement along the cyclothymia-schizothymia dimension, but two studies have also been made along other dimensions of personality. The first was that of Eysenck (80), who studied the colour-form reactions of 50 hysterics and 50 dysthymics, using three different tests: the "Ring" test, as previously used by Lindberg (177), a "Similarities" test, and a "Ranking" test. The "Similarities" test consisted of four cards, on each of which eight coloured shapes were arranged in a circle. The first card was for demonstration purposes, while the remaining three cards constituted the test proper. Each of these three cards contained three figures of the same colour but of different shape, and three figures of the same shape but of different colour. The three test cards differed from each other both in their choice of colours and in their choice of forms which were similar. In the demonstration card there were three figures identical in both form and colour, but in presenting this card to the subject the experimenter referred only to the similarity between the two figures, and avoided reference either to form or colour. After the demonstration the subject was presented with the three test cards in turn, and was asked to find three figures which were similar on each card.

In the "Ranking" test the subject first ranked in order of preference ten uncoloured polygons, and then ten colours. He was next presented with ten coloured polygons in which the most preferred polygon appeared in the least-liked colour, and so on, and was again asked to rank them in order of preference. This final ranking was then correlated with his ranking of the uncoloured polygons (or colours): the size and sign of the correlation coefficient indicated the strength of the influence exerted by colour or by form. Results from the three tests showed that the neurotics as a group were more colour-reactive than normals, but the hysterics and dysthymics were not differentiated with respect to their colour-form reactions.

A similar investigation was undertaken by Clarke (47), who investigated the colour-form reactions of neurotic and normal subjects by means of the Lindberg "Ring" test and the Sorting test, previously used by Eysenck in his investigation of psychotics. In administering the "Ring" test, Clarke noted certain ambiguous responses in which colour was mentioned as an indicator of differences in form (e.g., "The red ring has an arrow head a short distance from its shaft, while the blue ring has its arrow head attached to the shaft"). Finding that Lindberg's scoring procedure does not allow for such cases he introduced a third scoring category. No significant differences were found on the colour-form "Sorting" test between the groups studied, although the neurotics tended to sort more for colour than did the normals, and there was a tendency for the hysterics to be more colour-reactive than anxiety states. On the "Ring" test there was a statistically insignificant tendency for neurotics to be more colour-reactive than normals, using Lindberg's scoring categories, but hysterics were not more colour-reactive than anxiety states.

In summary, it would appear that colour-form tests may provide a means for measuring along two main dimensions of personality: first, along Kretschmer's dimension of "cyclothymia-schizothymia" and, secondly, along the normal-neurotic continuum of Eysenck (80). Several problems remain to be solved before satisfactory tests can be developed. There is first the problem of the relative generality or specificity of colour-attitude, which has been ignored by earlier writers; while assuming that colour attitude is a general trait operating in a variety of perceptual situations, little work has been done to show exactly how comprehensive this factor is. Results obtained in two investigations suggest that it may be much more specific than has been supposed. Thus, Eysenck (80) found only a small average correlation (.24) between the three tests used in his investigation, while the correlation between Clarke's tests was .152. On the other hand, Huang (129) obtained fairly high correlations between different tests of colour-form attitude, but as Eysenck (80) has pointed out, his tests were too similar to settle the issue. To

reach a decision it would be necessary to undertake a more extensive investigation ; such a study is now being carried out at the Institute of Psychiatry by Keehn, but no analysis of his data is yet available.

In the second place it would be desirable to formulate the colour-form hypothesis itself in more precise terms so that its consequences could more easily be deduced at the experimental level ; this problem of formulation is, of course, linked with the first problem of the relative generality or specificity of the hypothetical attitude. Thirdly, the possibility should be considered that colour-form attitudes may be a manifestation of a more general "analytic-synthetic" factor in perception. Indeed, two recent studies by Lindberg (178, 179) suggest that this may be so, as does Schiller's (251) finding that subjects who were "sensitive" to colour on the Rorschach gave global responses on his optical illusion tests.

In this connection the recent tendency towards a more experimental development of the Rorschach test, as seen in the work of Dubrovner, Lackum and Jost (65), Goodman (104), Lazarus (172, 173), Sipola (265), Wallen (299) and other investigators mentioned in Eysenck's (82) convenient summary of recent Rorschach research, may prove valuable for our understanding both of colour-form and analytic-synthetic attitudes. This tendency is to be welcomed and may, to some extent, reflect the growing awareness that the Rorschach deals, like any other personality test, with selected dimensions and traits (83, 282), and not with the "total personality" as some Rorschach workers have claimed. The essentially "dimensional" nature of the test is brought out in the language used by Rorschach workers to describe the personality dimensions on the one hand (anxiety, security, etc.), the objective stimulus dimensions on the other (colour, form, shading, etc.), and the postulated interrelations between the two.

(b) *Analytic-synthetic attitudes*.—One of the earliest writers to postulate a connection between different modes of perception and personality traits on the basis of experimental work was Benussi (16). In tachistoscopic experiments on what he termed *Gestaltzeit* he found two main types of response : on the one hand were subjects who experienced the Müller-Lyer illusion with short exposure times (82 to 100 ms.), while on the other hand were those subjects who required exposure times of 1,000 to 1,600 ms. Whereas the former group saw the parts of the figure, the second saw the whole figure best, with long exposures. On the basis of these results Benussi postulated two types of perception, the analytic, who react to parts first and require time to perceive the whole, and the synthetic, who perceive the whole first and require time to perceive the parts. Unlike Wertheimer and the Gestalt theorists who regarded the perception of wholes as the "natural" mode of response, Benussi regarded both types of perception as "normal" but representing two different traits of personality. Benussi made no direct attempt to develop this line of research.

Other writers, including Stout (275), Rorschach (246), Burt and Moore (37) and Bartlett (12) have, in different contexts, made the distinction between analytic and synthetic modes of perception, while Kretschmer (167) has made a similar distinction in his concept of dissociation-integration. Kretschmer's hypothesis has the great advantage over other formulations in that it forms part of a general framework of theory and empirical research in the field of personality. Kretschmer claims that dissociation characterizes the personality of the schizothyme, while integration, its opposite, is characteristic of the cyclothyme mentality. By "dissociation" Kretschmer means, "The ability to form separate and partial groupings within a single act of consciousness : from this results the ability to dissect complex material into its constituent parts." When this ability is absent, as in the cyclothyme, perceptions tend to be dealt with in a concrete, synthetic manner. The tendency towards dissociation is seen in an exaggerated form in the schizophrenic, while the integrative tendency, when exaggerated, characterizes the manic-depressive.

A number of experiments has been undertaken to test this hypothesis, many of which are of a visual nature, although of course Kretschmer's concept is not restricted to the visual system. Some of these experiments will be reviewed to show that there is considerable empirical support for the hypothesis.

In a tachistoscopic experiment Kibler (156) presented groups of coloured nonsense syllables to his subjects, with the instruction to observe either the colour or the letters. On the basis of Kretschmer's hypothesis one would expect the schizothymes, with their greater analytic and abstractive ability, to be able to observe

what is required by the instructions, and to discount other aspects of the stimuli, whereas the cyclothymes would be more influenced by field effects and would in consequence report less of what was asked for. The author found that about 30 per cent. of the leptosomatics and schizophrenics showed a complete failure to notice or remember stimulus characteristics other than the ones asked for, but only about 4 per cent. of pyknics and manic-depressives showed this extreme dissociative ability.

Enke (72) presented ten exposures of long, unfamiliar words in a tachistoscope and found that his subjects perceived the meaning of these words in two different ways: first, the analytic method, in which the whole was constructed by the combination of successively-apprehended parts, and secondly, the synthetic approach, in which an "impression" was first obtained of the whole, and this was elaborated in successive exposures. The ratio of dissociative over integrative modes of perception was 3.3/5.1 for pyknics, 5.7/3.0 for athletics, and 6.0/2.0 for leptosomatics. These results are consistent with the hypothesis, the leptosomatics showing marked dissociative ability, the pyknics showing relative absence of that ability, and the athletics taking up a position intermediate between the two extremes.

Experiments in which this time pyknics and manic-depressives appeared to gain the "advantage" over leptosomatics and schizophrenics with regard to accurate performance of the task were undertaken by Kibler (156) and Van der Horst (288): the authors claimed that pyknics and manic-depressives had a greater span of apprehension in the perception of letters exposed tachistoscopically. Enke (72), however, failed to confirm these findings. Confirmation might support Kretschmer's view that in virtue of the cyclothyme's greater synthetic and integrative ability he should excel at tasks of this nature. Enke (71) carried out a further study in which he compared the number of whole vs. detailed responses given by pyknics and leptosomatics on the Rorschach test. A significant difference was found between the two groups, at the $P < .01$ level, the pyknics giving 20 per cent. of whole answers, while the leptosomatics gave 23 per cent.

Other researches which are fairly typical of German work in this field are those by Schiller, Wachter, and Syldath. Schiller (251) presented the Müller-Lyer and Sander's illusions to his subjects, with the instructions that they were to adjust the length of one line to appear equal to the other; the same subjects were also given the Rorschach test. Two main types of response were distinguished, the global and analytic, and a correlation of .73 was found between these two classes on the two illusion tests. There was no significant relationship between the illusion test results and Rorschach responses, interpreted in terms of global and analytic perception, but an interesting finding was that 90 per cent. of the subjects who were sensitive to colour on the Rorschach showed global responses to the illusion tests, while 70 per cent. of the subjects who responded to form on the Rorschach showed analytic responses to the illusions. No precise statistical treatment of the data is given.

Wachter (296) presented various optical illusions to a group of normal subjects, classified as schizothymes and cyclothymes, and a group of psychotics (including about twice as many schizophrenics as manic-depressives). Results showed that the schizothymes and schizophrenics were less susceptible to the illusions than were the cyclothymes and manic-depressives. Syldath (277) estimated the susceptibility of subjects to a number of optical illusions and was able to divide them into two types, analytical and totalizing. He found that for the latter group brightness transformation and the Aubert-Förster phenomenon were more marked, but the subjects were less susceptible to contrast effects.

One of the few studies by British investigators in this field in recent years was undertaken by Eysenck (78), who gave a battery of tests, including the Müller-Lyer illusion, eight tests of suggestibility and two tests of perseveration to 60 mental hospital patients. On the basis of clinical ratings half the subjects were classified as hysterics, while the other half were free from hysterical symptoms. Results showed that susceptibility to the Müller-Lyer illusion was unrelated to suggestibility and to hysteria, but it was positively related to perseveration, a personality correlate not previously considered in this field.

On the American side, a factorial study by Thurstone (281) seems to have some bearing on the hypothetical analytic-synthetic factor. In this investigation a number of perceptual tests was included which, on the basis of their structure, would appear to involve analytic vs. synthetic or dissociative vs. integrative

abilities. These tests were the Gottschaldt Figures (two sets), Shape Constancy, Space Perception, Brightness Contrast, and Hidden Digits. Factor analysis indicates that all these tests have fairly high saturations on Thurstone's Factor A, which he tentatively identifies as representing the "ability to form a closure in a given presentation," especially when the subject must form the closure "against some distraction." Other tests in Thurstone's battery which one might suppose to be dependent on an analytic v. synthetic factor were five tests involving optical illusions: the Müller-Lyer, Sanders, Poggendorff, Ehrenstein, and Titchener illusions. These tests did not have saturations on Factor A, but Thurstone notes that the correlation between Factor A and Factor B (which defines the illusions) is $+ .23$; he goes on to say, "This is of some interest, because there are only four correlations among the perceptual factors identified in this study that exceed $.20$ " (281, p. 105).

Tests which had lower saturations on Factor A than those previously considered were the Street Gestalt Completion, Dotted Outlines and Mutilated Words. On the basis of their structure one might suppose these tests would involve integrative ability to a marked extent. These results, considered in relation to Thurstone's discussion and attempted interpretation of his perceptual factors, do suggest that all the tests that have been mentioned depend to varying degrees on an underlying factor contrasting analytic with synthetic modes of perception. The nature of this factor would probably become more obvious from an independent study undertaken with the specific intention of isolating it.

Related to Thurstone's investigation and to the analytic-synthetic factor is a study by Witkin (315), in which a positive correlation was found between combined scores on three tests of spatial orientation and a Gottschaldt Figures test. Separate correlations were calculated for men and women: these were $.66$ and $.46$ respectively. Taken in conjunction with Thurstone's analysis of the Gottschaldt figures test, these results suggest that the analytic-synthetic factor may extend to the field of space perception.* A factor which underlies responses to simple geometrical figures on the one hand and our perception of the upright in space on the other would be of a fairly comprehensive kind, and likely to have a fundamental basis in personality organization. Difficult to explain at present is the sex difference which was found, in Witkin's study, where the women consistently adopted a synthetic approach to perceptual problems, as contrasted with the analytic mode of perception in the men. A similar difference (though slight) appeared in Thurstone's study between sex and susceptibility to optical illusions, women being more susceptible than men. However, results obtained in another study by Witkin, (315), on the developmental aspects of space perception, suggest that this sex difference may not be a fundamental one, for a significant difference between the two sexes in their relative dependence on visual field factors did not appear until the age of about 18 years.

Although concerned ostensibly with a different dimension, the studies of Klein and Holzman (158) on "levelling vs. sharpening" attitudes may also be mentioned as having some bearing on the analytic-synthetic factor, for subjects who showed "adaptive lag" in an experiment on "visual schematizing" obtained poor scores in a Gottschaldt Figures test and a test of Hidden Pictures: in all three situations they were apparently unable to overcome the influence of field effects.

Finally mention may be made of studies on constancy effects, such as that of Thouless (280), in which he noted that subjects of a "schizothyme" temperament showed a greater tendency to perceive the stimulus or perspective object than did "cyclothymic" subjects. A later investigation by the same author failed to confirm this relationship but, as Thouless himself points out, his selection procedure was not entirely satisfactory and may have obscured a real correlation. An interesting hypothesis that could be tested in this field has been put forward by Bruner (33, p. 142) on the basis of psychoanalytic theory. If, Bruner argues, schizophrenia is a regression to primary narcissism, a withdrawal from object relationships, might we not predict that such a withdrawal, and the increasing concern for the self, would lead to a breakdown in such phenomena as size and shape

* This correlation provides a link with Witkin's well-known series of researches on spatial orientation (314, 315 and references), which in turn appear to be related to the work of Sandstrom (248), Angyal (3), Claparède (46), and research on the Aubert phenomenon, such as that of Ogata (220).

constancy? A test of the hypothesis, which may of course depend on nothing more than a superficial analogy, would have to take into account the various factors which Thouless (280), Sheehan (260) and others have shown to be related to constancy effects.

(c) *Oscillation*.—A stimulus to research in this field was provided by McDougall's theory of introversion-extraversion (202, 203), in which he claimed that these two basic attitudes depend on the speed at which impulses travel in the central nervous system, particularly in the higher centres. This "speed of nervous action" could be studied by determining a person's rate of reversal of ambiguous figures, such as the Necker cube, Windmill illusion, Goblet figure, etc., and McDougall produced a certain amount of evidence to show that a rapid rate of reversal was characteristic of introverts while a low rate was characteristic of extraverts. (It should be noted that McDougall made no distinction between the dimensions of introversion-extraversion and schizothymia-cyclothymia.)

Guilford and Hunt (113) tested the rate of reversal of perspective in 25 college students, using a cube figure, and correlated the results with scores on three personality inventories: all three correlations were low but, as Eysenck (80) has pointed out, this result cannot be considered fatal to McDougall's theory in view of the many criticisms of self-rating questionnaires of the type used in this study. In another experiment Hunt and Guilford (132) gave two forms of a reversal of perspective test to 19 manic-depressive and 26 schizophrenic patients, first with the subject adopting a passive attitude and, secondly, an inhibitive attitude toward the reversal. Results showed that with the passive attitude normals and schizophrenics gave 18 and 17 reversals per minute respectively, while the manic-depressive patients gave only 4 reversals; with the inhibitive attitude normals gave 9 reversals, schizophrenics 13, and manic-depressives 2. Paranoid schizophrenics showed rates intermediate between those of the other schizophrenic patients and manic-depressives. These findings are in the direction predicted from McDougall's theory.

Cameron (40) reports results similar to those of Hunt and Guilford; a particularly interesting finding in his investigation was that the fluctuation rate of depressive patients tended to increase as the patients recovered, and the test results tended to become more regular. Frederiksen and Guilford (93) verified the earlier conclusions reached by Guilford and Hunt (113) that the rate of fluctuation of an ambiguous figure cannot be used as an objective test of introversion-extraversion, but their criterion suffered from defects similar to those previously pointed out by Eysenck (80).

George (100) used the Windmill Illusion, the Maltese Cross, two tests of binocular rivalry, and various rating scales to investigate, first, the relation between rate of fluctuation in binocular rivalry and reversible perspective and, secondly, the relation between these tests and introversion-extraversion, as measured by rating-scales. He found a general factor underlying the fluctuation and binocular rivalry tests, which correlated .52 with the rating scales. Johnson (144) took four samples of rate fluctuation, each lasting one minute, from subjects during both euphoric and depressed moods, and found, contrary to previous findings, a significantly greater rate of fluctuation in the depressed than in the euphoric state. Porter (229) found that subjects with a rapid reversal rate on 15 ambiguous figures tended to be more socially introverted, as measured by the Nebraska personality inventory, than subjects with a slower rate.

In an attempt to differentiate between hysterics and dysthymics by means of oscillation tests Eysenck (80) gave the Maltese Cross and Goblet tests to 34 hysterics and 38 dysthymics, each test being given twice, first with instructions to adopt a passive attitude, and second with instructions to adopt a maximizing attitude (i.e., to get as many reversals as possible). No significant differences were found between the hysterics and anxiety states, but the reversal rate for the neurotic group as a whole was significantly lower than for normals (as determined from the literature). Eysenck links this result with McDougall's theory that cerebral activity inhibits the activity of the lower centres, but notes that his results require confirmation in a properly-controlled experiment before any final attempt at explanation need be made.

In a later investigation Eysenck (84) studied the reversal rate in 50 schizophrenics, 50 depressives and 100 normal subjects, on the Necker cube test, with the following attitudes adopted: passive, maximizing, minimizing, and passive, each

for a period of 30 seconds, and in that order. The results of the first period showed no significant differences between the three groups, but the results of the maximizing period gave differences between the controls and depressives at the .05 level of significance, and between the controls and the total psychotic group at the .01 level of significance. The means were: 16.90, 11.26, and 10.74 for the controls, schizophrenics and depressives respectively. The minimizing period gave significant differences between the controls and depressives at the .001 level, and between the schizophrenics and depressives at the .05 level, the means for the control, schizophrenic and depressive groups being 2.93, 2.44 and 1.46 respectively. The final period differentiated between the controls and the total psychotic group at the .01 level; between the controls and schizophrenics at the same level of significance; and between the controls and depressives at the .05 level. The means for the three groups were 7.41, 4.56 and 4.72 for the controls, schizophrenics and depressives respectively.

Gravely (109) gave the Necker cube test to groups of normal subjects and anxiety neurotics in the same manner as in Eysenck's research on psychotics, but failed to find any significant differences between the three groups for all four periods. Working within the framework of Sjöbring's theories, Siegvald (264) found that "subvalid" subjects (i.e., individuals who, according to Sjöbring, have a fairly small supply of energy for brain processes) show a greater frequency of figure-ground reversals than "supervalid" subjects.

In addition to the above researches on the relation between reversal rate and temperament and character, mention may also be made of the work of Hoffeditz and Guilford (124), George (100), Denton (58), Thurstone (281) and Eysenck (80), who have all found fairly high positive correlations between different tests of reversal of ambiguous figures; their results suggest that there may be a group factor of "oscillation" which is relatively independent of general intelligence.

Although not concerned explicitly with oscillation as such, the recent studies by Frenkel-Brunswik (94) on "tolerance vs. intolerance of ambiguity" seem to have a bearing on the subject. This postulated attitude has its origins in the typological speculations of Jaensch (139) and in psychoanalytic theory. On the basis of research on eidetic imagery, summarized by Klüver (160, 161, 162), in which he distinguished two main types of imagery, stable and labile, Jaensch postulated two fundamentally different modes of psychological functioning, an integrate type and a non-integrate type, which are in turn related to the fundamental biotypes of W. Jaensch (140). Owing to a basic "unity of style" within the personality, characteristics in imagery may be linked with reactions to various perceptual tests (such as adjustment to prismatic lenses which distort the visual field, after-movement phenomena, reactions to visual illusions, binocular disparity, etc.), and extend to memory, thinking, and to social and political attitudes. The essential contrast in Jaensch's system is between the well-adjusted individual who is "intolerant of ambiguity" at all levels, and the unstable individual whose "tolerance of ambiguity" in his perceptions is associated with a "morbid liberalism" in the social and political sphere.

There are many non-scientific facets to Jaensch's theory and experiments, of which Frenkel-Brunswik is well aware, but she is interested in his work for two reasons: first, it centres on the concept of "ambiguity" and, secondly, a "unity of style" is postulated between the various areas of ambiguity. While she accepts the postulated interconnection between these different areas, Frenkel-Brunswik regards the relationship between "tolerance of ambiguity" and personality integration as positive rather than negative, as Jaensch supposes.

With regard to the psychoanalytic background to her hypothesis, Frenkel-Brunswik cites the concept of "ambivalence," the existence of which in a person, and that person's ability to face his or her ambivalences towards others, "must be considered an important personality variable." She points out that such a "formal" psychoanalytic factor is more amenable to experimental test than are those factors which deal more directly with "content." This variable Frenkel-Brunswik attempts to link with the more "cognitive" formulation of tolerance of ambiguity: she regards denial of emotional ambivalence and intolerance of ambiguity as but two different aspects of the same fundamental personality trait.

In working out her ideas on the experimental level, Frenkel-Brunswik makes use of Benussi's (17) concept of *Gestaltmehrfachdeutigkeit*, its development by Rubin in his well-known work on figure-ground reversals, and its extension by Gestalt psycholo-

gists (164). So far, Frenkel-Brunswik's research is only in its preliminary stage, but it looks as if there may, under certain conditions, be some connection between tolerance of ambiguity in perceptual tests of figure-ground reversals, freedom from ethnic prejudice, and related personality variables. If this should prove to be the case, Frenkel-Brunswik's work may serve to link the earlier studies on oscillation, which originate in McDougall's physiological theorizing, with typological research, psychoanalytic theory, and research on primary social attitudes (81).

Closely linked with Frenkel-Brunswik's hypothesis is Klein's (157, p. 342) postulated dimension of "tolerance vs. resistance to the unstable." Experimental work by Klein and his associates suggests that "tolerance to the unstable" may be a fairly fundamental dimension, which extends from ease of perception of apparent movement (the phi phenomenon) and the autokinetic effect to "form lability" in Tschach responses and the early recognition of distortion induced by the wearing of aniseikonic lenses.

Also related to this area of research are two studies by Gordon (105, 106), who has investigated imagery types (fluctuating and rigid) in connection with the formation of cultural stereotypes and perceptual rigidity, while the numerous studies on after-images or eidetic images by Schmülling (253), Smith (268), Liefmann (176), Fischer and Hirschberg (90), Zeman (320), Roessler (245) and other writers of typological persuasion may be of value to those who wish to experiment in this field.

(d) *Visual-aesthetic factors.*—Some readers may express surprise at the inclusion of aesthetic preferences in a paper which purports to deal with visual perception, but in view of the work of Koffka (165), and other Gestalt writers, on the "artistic" nature of perception, Helson's (121, p. 359) inclusion of affective or preferential value as a fundamental dimension of colour stimuli, along with their properties of hue, value and chroma, etc., and the experimental researches of Eysenck (77), Guilford (112), Granger (112) and others, who have shown a close connection between the perceptual dimensions of various types of stimuli and their aesthetic properties, there no longer seems any justification for isolating the aesthetic element from other aspects of perception, even though this may conflict with some of the traditional (but unverified) notions of the structure of the mind. With Dashiell (54) the author would agree that progress in both disciplines, aesthetics and perceptual research, would be hastened if they were treated together, as two aspects of the same science.

That aesthetic appreciation and personality are closely related has often been maintained; in particular, it has been supposed that a significant relationship exists between aesthetic preferences and temperament. Among modern aestheticians who have postulated this relationship Evans (74) and Read (234) are probably the best known. Both writers have attempted to relate aesthetic appreciation to Jung's typology, and their researches provide a useful introduction to the more theoretical aspects of the subject. In making his analysis Read has drawn on the work of Riegl (241), who distinguished between geometric and naturalistic types of art, Wölfflin's (317) theory of objective contrasts (linear v. painterly, surface v. depth, closed v. open form, etc.), Dvorak's (68) distinction between idealism and naturalism, and the studies of Max Verworn (290) and Herbert Kühn (169) on primitive art. He also refers to the well-known perceptive types of Bullough (36): objective, physiological, associative, and character types,* and the parallel types of Binet (24), which he identifies with Jung's four basic psychic functions.

Of the experimental researches in this field, the most relevant for personality study are those of Eysenck. In one study (75) he presented five sets, each containing 30–50 pictures, to 15 subjects who were asked to rank them in order of preference, according to a scheme of grouping. The rankings were intercorrelated, and the resulting matrix factorized to give two factors: one was the general factor of aesthetic appreciation, while the other contrasted preferences for the "simple, highly unified, vividly coloured, modern type of picture" with preferences for the "complex, less 'poster-colour,' more diversified picture". A questionnaire investigation showed that extraverts tended to prefer the former type of picture while introverts preferred the latter.

* These types may be of value in connection with Klein's recent work on the "Physiognomic vs. literal" dimension (157), in which he draws on the researches of Kouver (166), Storch (274), Arnheim (5), Werner (307) and Hanffman (116) on physiognomic modes of experience.

In a later study, Eysenck (80) presented reproductions of 16 pairs of landscape paintings to 50 hysterics and 50 dysthymics for preference judgment. The pictures were selected so that the items in each pair depicted the same subject, were of equal artistic merit, but differed in style: one was painted in the "colourful, simple, modern manner," while the other was painted in the "more detailed, less colourful, older manner." The score on the test was the number of modern pictures preferred to the older. Results indicated that hysterics showed a greater preference for modern pictures than did dysthymics.

Other results which are relevant to this review have been obtained in the field of colour preferences. Barrett and Eaton (11) studied the preferences of women college students for colour or tint, and found that subjects preferring colours had fewer associations to words, higher annoyance scores, lower morale scores, took longer to complete an annoyance test, were more masculine, and changed their minds on social and economic issues less frequently than subjects who preferred tints: they also seemed to respond more directly and with greater interest to objects and objective events. Rakshit (232) found that subjects who tested as extraverts on the Neymann-Kohlstedt examination preferred the "deeper" colours (blue, red, and green), while introverts and "neuroverts" preferred orange and violet. Shikiba (263) investigated the colour preferences of 247 subjects, including psychiatric patients and delinquent boys, by means of six Zimmerman papers. His results are in line with those obtained in the studies of colour preferences which have been summarized by Eysenck (76) and Granger (107): these studies indicate a general order of preference to which all subjects tend to conform. Certain differences appeared between the rankings of the various psychiatric groups: for instance, manics put red first in order of preference, while depressives ranked it last. Katz (150) studied the colour preferences of psychiatric groups, and found that red, orange and yellow were more pleasing to manic-depressives than to any other diagnostic group. Dorcus (64) compared the colour preferences of a psychiatrically undifferentiated group of 19 male and female patients for a set of Munsell colours with those of several non-psychiatric groups of considerably larger size, but found no significant differences in their choices.

Thomaschewski (279) in a study of 700 children found that colour preference showed a consistent relation to social adjustment, temperament and initiative, but owing to the author's use of rather subjective procedures it is difficult to evaluate his findings. In the most systematic study yet reported in this field Warner (301) presented Munsell papers against a neutral grey background to 60 patients suffering from anxiety states, 60 manics, 60 depressives, and 120 catatonic schizophrenics; the latter group was further subdivided into equal groups of "active" and "passive" patients. In each group there was an equal representation of the sexes. Results showed that while there were marked sex differences with respect to all three attributes of colour, the only differences between the psychiatric groups were that anxiety states showed greater preference for the lighter colours, and they also expressed stronger preference for green than for yellow. Warner points out a limitation of his findings, due to the influence of extraneous variables in the criterion groups.

The most recent study of colour preferences in relation to personality differences is that of Robertson (243), in which a set of 14 colours was presented for preference ranking to 36 schizophrenics, 36 "non-schizophrenics" (a group including depressive patients and neurotics), and 18 nurses. The colours were as follows: dark red, light red, dark yellow, light yellow, dark green, light green, dark blue, light blue, purple, mauve, black, brown, grey and white. No attempt was made to specify these colours in objective terms, but fortunately this does not prevent a comparison being made between the average rankings of the three groups. Robertson shows by statistical analysis that the schizophrenics liked dark green better and white worse than did the non-schizophrenic group; the schizophrenics liked mauve better and white worse than did the nurses; and the non-schizophrenics liked dark green worse than did the nurses.

The present writer has undertaken a rather different analysis of Robertson's data with the object of determining, first, the amount of interpersonal agreement within the three groups and, secondly, the degree of association between the orders of preference for the three groups. From the set of average rankings given by Robertson in his paper it is possible to calculate the amount of agreement in terms of Kendall's (154) coefficient of concordance, W , a simple function of the average Spearman intercorrelation coefficient. When this is done, the following values of W are obtained:

schizophrenics, $W = .07$; depressives and neurotics, $W = .18$; nurses, $W = .27$. The first of these coefficients is significant at the $P < .01$ level, while the second and third are significant at the $P < .001$ level, indicating that in all three groups there is sufficient agreement from which to derive a general order of preference. This result is interesting when considered in relation to work on the general order of colour preference (76, 107), for it looks as if the interpersonal agreement which has been found elsewhere in normal groups also exists in groups of psychiatric patients. Perhaps significant, however, is the fact that agreement tends to be much less in the schizophrenic group than in the others; this cannot at present be proved satisfactorily, owing to the absence of suitable tests.

When the general order of preference for each group is derived by allotting ranks in accordance with the averaged observed ranks given by Robertson, rank 1 being allotted to the smallest average rank, rank 2 to the next largest, and so on to rank n , and the resulting rankings are submitted to analysis of variance, the result is very striking: there is evidence of a significant association at the $P < .01$ level. Further, although the writer has not made any precise calculations, examination of the ranks allotted to the blues, reds, greens, yellows and purples seems to indicate that the order of preference agrees closely with that found in normal groups.

In addition to collecting preference rankings for single colours, Robertson also presented combinations of colours for rating by the same groups of subjects. He found that the schizophrenics showed greater liking for combinations containing mauve and less for those containing white than did the depressives and neurotics; they also showed greater preference for combinations containing dark red or mauve and less for those containing white than did the nurses. The depressives and neurotics showed greater liking for combinations containing dark red and less for those containing dark yellow than did the nurses. As for the consistency shown by subjects in their preferences on different occasions, this was significantly less for the schizophrenics than for the other two groups, and the depressives and neurotics were less consistent than were the nurses.

Robertson also made an analysis of the use of colours in the paintings of a group of 176 patients, including schizophrenics, depressives, psychopaths, and neurotics, and came to the conclusion that "the central factor underlying all the peculiarities in the use of colour in painting by seriously disordered patients is a diminished feeling for colour or a weakened reactivity to it." One particularly striking result which he mentions was that the seriously disordered patients used colours of the blue-red series more than did other patients or normals. Robertson considers that his findings lend support to Kretschmer's (167, p. 240) views on the colour reactions of psychiatric patients, but they appear contrary to those of Goldstein (103), who has stated that the influence of colours is increased in psychotics. No evidence was found to support the contention made by Mosse (215), Emery (70) and Birren (25) that schizophrenics show a particular liking for yellow, nor was there evidence to support Mosse's (215) claim that depressives make great use of black. Owing to the number of variables involved, this part of Robertson's work is less easy to evaluate than his investigation of preference judgments for single colours and binary combinations. However, he has made a systematic attempt to develop a field which is still largely characterized by vague speculation and untestable hypotheses.

A further group of studies on mosaic tests may also be mentioned. Although, like the latter part of Robertson's work, they are primarily concerned with aesthetic production rather than with aesthetic appreciation, it may be supposed that the factor of aesthetic preference plays a sufficient part in these tests to warrant their inclusion in this review. In the typical mosaic test, such as that devised by Lowenfeld (184), the subject is presented with a box containing various shapes, each of which is available in several different colours, and is asked to make something. The finished pattern is then classified according to various criteria, and it is claimed that a significant relationship exists between characteristics of the pattern and the personality of the person who made it. For instance, in children and young people the use of many black pieces is supposed to be associated with depression, designs edged with projecting red pieces tend to be made by excitable and impulsive people, while edge, frame, winged and arrow designs are supposed to characterize persons suffering from functional disorders.

The few reports which are available concerning the scientific value of this test suggest that temperamental factors may be reflected to some extent in the choice of colours and shapes. Thus, Diamond and Schmale (61) found a greater insistence on

colour-balance in the designs of manic-depressives than in schizophrenics, while Wertham and Golden (308) were able to differentiate between schizophrenics, manic-depressives, mental defectives, and patients with organic brain lesions, on the basis of their mosaic patterns. Himmelweit and Eysenck (123) studied the mosaic designs of hysterics and dysthymics, but failed to find any differences between the two groups in their choice of colours. They did find significant differences in the type of pattern produced: whereas the hysterics tended to produce designs of an abstract and scattered nature, the dysthymics produced concrete and compact designs. These observed differences in the mosaic constructions of different groups, implying as they do differences in preference for form and colour, may prove of some value in the construction of visual-aesthetic tests of personality, but most of the work on mosaic tests has not yet reached a stage where its scientific significance can be evaluated.

It would appear from this review of visual-aesthetic factors that further development of the field will provide a fruitful approach to personality study. One line which such development might follow would be to identify in more precise terms than hitherto the objective stimulus properties which characterize the aesthetic preferences of different temperamental groups. This would involve preliminary analyses of the type made by the more scientifically-minded aestheticians, such as Pope (227) and Graves (110), in order to suggest hypotheses as to some of the main determinants of preference for complex pictorial compositions. At the same time, studies could be planned at a more elementary level, with simple colour-form combinations, along the lines of those undertaken in the general psychology of aesthetic appreciation by Guilford (112), Davis (56), Beebe-Center and Pratt (13), Harsh *et al.* (120), Eysenck (77), Granger (108) and others. Such researches should eventually enable some of the vague descriptive terms at present in use, such as "classical," "romantic," "compact," and so on, to be given more precise definitions; this should in turn help to throw further light on the temperamental types whose preferences are being studied.

III. THEORETICAL DEVELOPMENTS.

With the growing awareness of the relationship which exists between personality and perception, several attempts have been made in recent years to develop theories of personality "dynamics," which are based on a functionalistic view of perception. Much of the relevant literature on the subject is contained in a number of papers appearing in the September and December, 1949, issues of the *Journal of Personality*, and in the recent publication, *Perception: An Approach to Personality* (26). As reviews of these researches have already been provided by MacKinnon (205) and Blake (26, pp. 10-22) they will not be dealt with here in detail, but mention will be made of what seem to the writer to be the three most important contributions, namely those of Bruner (33), Klein (157) and Frenkel-Brunswick (95). Before discussing these contributions, it may be noted in passing that, while the large volume referred to above (26) on perception and personality has been of importance in stressing the need for integrating two fields of research that have been pursued independently of each other, its scientific content falls short of what one would have hoped for. There is an undue amount of verbiage and vague speculation to be encountered in attempting to extract the useful ideas and information which it undoubtedly contains.

Bruner's aim has been to seek a theory of perception which is "adequate both to the laboratory and to the clinic"; above all, one which will account systematically for individual differences in perception, and not assign them, in the Fechnerian tradition, to random error. On the basis of a series of experiments undertaken in collaboration with Postman, Bruner has developed an "expectancy" or "hypothesis" theory of perception. In his view perception involves a three-step cycle: it begins with an expectancy or hypothesis which is evoked "from the arousal of central cognitive and motivational processes by preceding environmental states of affairs" (33, p. 124). The second step in the process involves the input of information from the environment (both external and internal), and finally a checking procedure takes place—input information is either confirmatory to the hypothesis or it is in varying degrees infirming. Should confirmation not occur, the hypothesis shifts in a direction determined partly by internal, subjective factors and partly by feedback from the learning which occurred in the preceding information-

checking cycle. Whereas the first hypothesis is termed the "initial" hypothesis, those which follow an infirmed hypothesis are known as "consequent" hypotheses.

Bruner's development of his basic notion may be summarized in terms of three theorems which deal with the concept of "strength" of hypothesis: (1) The stronger a hypothesis, the greater its likelihood of arousal in a given situation. (2) The greater the strength of a hypothesis, the less the amount of appropriate information necessary to confirm it. (3) The greater the strength of a hypothesis, the more the amount of inappropriate or contradictory information necessary to infirm it. Having formulated his general theoretical position Bruner proceeds to translate recent perceptual research into these terms, and to suggest how personality "dynamics" can function to control the selection of information, and in this way determine the ensuing reaction. When developed in greater detail, Bruner's theory may serve to integrate some of the experimental data in this field; at present its value is not easy to determine.

Klein's (157) approach, while in its insistence on perception-personality relationships essentially similar to Bruner's, tends to lay greater emphasis on individual differences. He accepts a functionalistic view of perception, and goes on to search for those perceptual properties which fulfil an adaptive function under the control of the ego-system. Among such properties he mentions absolute and differential thresholds, constancy effects, organizing time, and schematizing. These so-called "adaptive properties," common to all individuals, are employed "idiosyncratically," and the "personal styles" or modes in using them for meeting environmental demands are called "perceptual attitudes" or *Anschaunungen*. Such attitudes, or syndromes, of adaptive properties "reflect for us the integrative principles which give character and distinctness to perceptual life" (159, p. 43), and by studying the interrelations between them Klein hopes eventually to construct an empirical typology.

The point of departure for Klein's experiments is a perceptual task involving an "adaptive property" or properties in which individual differences are shown. By examining the experience of subjects who show extreme performances on this task two opposing attitudes are then formulated to account for the difference. The third step in the procedure is to seek other perceptual tasks which will "highlight" these attitudes and, by a process of internal validation, determine if the separation of the two groups is maintained in these tasks as well. This leads to a definition of the attitude in more general terms.

Finally, having confirmed and formulated the attitude in perceptual terms, it is appropriate to extend the search to concomitant aspects of the attitude, clinical, motor, physiological, and so on.

Klein also mentions a second procedure in which the starting-point is an hypothesis regarding an ego-control principle derived from clinical experience. This principle is then translated into perceptual terms and investigated as above.

Klein's theoretical position is in certain respects similar to that of Thurstone (281), who postulates in his *Factorial Study of Perception* that peripheral functions, in the perceptual system, may in certain cases serve central mechanisms, so that by studying the "dynamics" of one of those functions some characteristics of the person as a whole might be inferred. In fact, Thurstone includes some of the "adaptive properties" referred to by Klein (thresholds, constancy effects, and organizing time) in his test battery. Thurstone also adopts a similar position with regard to the verification of an attitude inferred on the basis of observed individual differences. If he finds individual differences "in some phase of perceptual dynamics which may be centrally determined," he would then go on "to list a few subjects whose perceptual performance has some conspicuous characteristic, and to list also some subjects who do not have that characteristic or who are the opposite. Then we should ask how these subjects differ. If it should be found, for example, that the subjects who show considerable lag in the method of limits are noticeably more deliberate in movement and temperament than those who show little or no lag in the psychophysical experiments, then we should have a lead for further . . . study" (281, p. 2).

Klein's eventual aim (to build an empirical typology based on perception) also links his work with the well-known researches of Kretschmer (167) and other continental typologists. In fact, Klein's work may be regarded as traditional typology in a somewhat different guise. Unlike the typologists, however, Klein has no com-

prehensive theory embracing the various aspects of personality, conative, affective, and constitutional.

Finally, note may be made of the connection between Klein's theorizing and Eysenck's (80) picture of personality organization. Klein's approach, like Eysenck's, claims to be dimensional and also hierarchical in conception, but whereas Eysenck has provided a theoretical framework based on experimental research on many different facets of personality—perceptual, motor, autonomic, and so on—Klein's perceptual theorizing so far tends to lack such a framework, which would seem to be essential if one is to integrate perceptual attitudes with a body of experimental fact on personality structure. It also suffers to some extent from not having a clearly-formulated dimensional methodology with which to pursue an essentially dimensional aim. Klein's conception of attitudes seems to fit in fairly well, however, with Eysenck's notion of higher-order concepts organized at the trait level (see his diagram of personality organization (80, p. 29)).

A difficulty which not only Klein, but other personality-oriented theorists seem not to have mentioned is that of deducing specific perceptual consequences from the general "ego-control" and other central factors that they would utilize for their experiments. It is one thing to speculate in general terms on the sort of consequences that are likely to arise from an "intolerance of instability," on the perception of autokinetic movement or flicker-fusion, but it is quite another thing to deduce what particular aspects of those phenomena are to be selected for measurement, the objective experimental conditions under which those measurements are to be made, and the variables that must be controlled when subjects are selected for experiment. At this stage the problem becomes formidable, and must necessarily involve consideration of a network of correlations between objective and subjective factors that are known to operate in all perceptual functions. However, to say that psychological theorizing in this field is still only at the formative stage is not to say that Klein has not made a valuable advance.

Frenkel-Brunswick's (95) contribution to theory has been primarily to attempt the integration of perceptual research with psychoanalytic theory of personality "dynamics" and with developments in the social psychological field. In particular, she indicates how interest within psychoanalysis itself has tended in recent years to shift from an almost exclusive preoccupation with the id and problems of "depth" to the ego and "surface" manifestations.

Influenced by psychoanalytic writings, and undoubtedly very sympathetic towards the psychoanalytic viewpoint, Frenkel-Brunswick shows the possibility of submitting psychoanalytic concepts, such as the various defence mechanisms, to experimental test by deducing their consequences in the perceptual system. This tendency to link psychoanalysis with other branches of psychology is to be welcomed, and seems to be in line with Freud's own realization that psychoanalysis needs other departments of psychology to complement it. In his own words, psychoanalysis ". . . is seldom able to deal with a problem completely, but it seems destined to give valuable contributory help in a large number of regions of knowledge. The sphere of application of psychoanalysis extends as far as that of psychology, to which it forms a complement of the greatest moment" (96).

Of particular interest is Frenkel-Brunswick's view of the value to be derived from studying the "formal" elements in personality. She maintains that "the formal elements of personality style, since they are not as directly threatening as its content, are not subject to censorship in the same manner as its content, and that they, therefore, can be used as tools in diagnostic procedures" (95, p. 408). A study which she cites on mechanisms of self-deception seems to suggest that such formal style elements as exaggeration, easy generalization (as contrasted with salient specificity), intolerance of ambiguity, and the like, may be of greater penetrating power within the personality, more nearly alike on the surface and at greater depth, and thus of greater generality and greater diagnostic validity than such content factors as, say, sex, aggression, and the Oedipus complex. In this emphasis on the diagnostic significance of "formal" factors Frenkel-Brunswick's theoretical position bears an analogy to that of Klein's.

Not only does Frenkel-Brunswick draw on psychoanalysis for her guiding principles, but she also shows herself prepared to accept some of the ideas of continental typologists, as has been shown in her development of the concept of "intolerance of ambiguity," discussed elsewhere in this paper; altogether she shows an awareness of converging trends of thought, originating from diverse sources, a

capacity which is to be welcomed in a focal area like that of personality study. The value of her theorizing (like that of Bruner and Klein) can, however, better be judged when it has been shown to integrate existing experimental data, and to point the way to further specific experiments.

IV. GENERAL CONCLUSIONS.

Evaluation of a complex field, in which experimental studies mingle with clinical observations and theoretical speculation, is not easy. However, from this mass of data a number of trends may be discerned which invite comment.

In the first place, it looks as if visual perception in its various aspects affords a promising approach to personality organization. This view is supported not only by clinical observation, but in many parts of the field by experimental research. This current interest and research in perception-personality relationships is welcome for it may, to some extent, serve as a point of unification for approaches as different as those of psychoanalysis and psychophysics, and thus prevent undue narrowing of outlook.

With this growing awareness that personality factors operate in perception, and the emphasis on a "personality-centred" approach, there is, however, the danger that in their enthusiasm advocates of this new (?) approach will cease being aware of those factors that sensory psychologists, physicists and physiologists have shown to be important influences on our perceptions. There are already signs in many of the researches that have been reviewed of a certain relaxation of experimental controls in regard to such objective variables as quality and quantity of illumination, retinal area stimulated, pre-adaptation, and so on, and in the failure to take into account the many other variables such as age, fatigue, refractive errors that are known to influence some of the phenomena that have been considered. This lack of rigour may, to some extent, be reflected in the embarrassingly large number of zero or near-zero coefficients that often occur in our correlation tables. Associated with this general tendency for fairly slipshod experimentation in the matter of controls is a failure to consider alternative hypotheses and to attempt some explanation of contradictory findings; all too often these are merely mentioned in passing, whereas they should be regarded as an essential part of research procedure.

Thirdly, realization of the importance of perception in the study of personality must not blind us to the value of other approaches, such as the motor and autonomic. This is not, perhaps, so likely to occur in visual perception as in other parts of the field for, at every point, the influence of motor and autonomic components makes itself felt. The warning nevertheless seems necessary in view of the current tendency to make something of a fad of this newly-developed interest in perception.

This leads to a fourth point, namely the necessity for linking work on perceptual tests of personality to a general theoretical framework which embraces all aspects of personality study. Such a framework is available in Eysenck's (80) hierarchical conception of personality structure, already referred to earlier in this article. In fact, to the author's knowledge it is the only existing framework that can serve to integrate the mass of data that already exists in the scientific study of personality. Such a system lays emphasis on personality organization at different levels of generality, and into this scheme can be fitted the results of researches on such hypothetical attitudes as colour-form, analytic-synthetic, oscillation, and so on. It has the merit of being based on empirical research, and it leaves room for extension and development as it becomes necessary to add new dimensions at different levels. Indeed this scheme appears as a fairly logical outcome of the dimensional approach to personality study which is adopted, explicitly or implicitly, by most of the writers whose researches have been reviewed in this paper.

A further aspect of Eysenck's general theoretical position, which is relevant, is the greater emphasis which he puts on constitutional and hereditary factors in personality than is common at the present time, a view supported by a recent experimental study of neuroticism in twins (85). In consequence of the importance which apparently attaches to these factors, tests of the various visual functions which have been reviewed in this paper would appear to have great potential significance as measures of fundamental factors in personality, for many of them have been shown to be strongly influenced by heredity. Some of the relevant studies which bear on this topic are those of Bracken (32) on susceptibility to the Müller-Lyer illusion, Aubert's phenomenon, and the apparent size of after-images; Hofstetter (125) on accom-

modation-convergence ; Malan (208) on spatial orientation ; Smith (268) on eidetic imagery and response time ; Lowenstein and Levine (194) on the pupillary light reflex ; and Eysenck and Prell (85) on flicker-fusion and autokinetic movement. Such tests of a " formal " sensory or perceptual nature may be contrasted with those employing comparatively unstructured material, such as the various types of projective personality test, where the greater influence of " content " factors tends, perhaps, to make them more subject to diurnal variations within the personality.

One final comment on the studies covered by this review concerns their almost purely descriptive and classificatory nature. This is to be expected in a relatively undeveloped field, but such classificatory research should be supplemented as early as possible by studies designed to determine the functions and mechanisms underlying the phenomena that have been described. To some extent hypotheses about the underlying functions may be available in existing psychological or psycho-analytical theories, as investigators like Frenkel-Brunswik (95) seem to suppose, but in the writer's view the most fruitful development of this particular field will be in terms of physiological or psychophysiological hypotheses. If, as is fairly apparent, tests of the type considered in this review are dependent on fundamental factors in personality which are closely bound up with the basic structure and physiological functioning of the organism, then it seems fairly logical that theorizing should have a definite physiological bias. With such theorizing should also go a greater degree of specificity and precision than appears in most of the theoretical speculations in this field : in many cases hypotheses at present are of such a general type, and couched in such vague terms, that it is difficult to deduce their consequences under specific experimental conditions.

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GENETIC INVESTIGATIONS IN TWINS.*

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I AM very grateful for the invitation of the Association to speak about the work I have been doing with twins, as it is an opportunity to thank the very many members who have helped in it. Without your kindness and co-operation the work would not have been possible. Medical Superintendents have put themselves out to make it possible for me to see patients and examine records; medical officers have discussed cases with me; I have been able to see the invaluable reports on family visits by social workers, and P.S.W's. have even made special inquiries on my behalf; hospital secretaries have made visiting books and other records available, and have rummaged through dusty files for ancient case-notes, and they have added to their labours routine inquiries about twinship which have considerably enlarged my series. This help has been given not only to me personally, but also to other workers collaborating with me. For all this and more, which I have no time to mention, I want to say thank you very much.

A full account of the results of the twin study will be published in due course as a Medical Research Council Report. What I should like to do to-day is to sketch some of the findings, and discuss some special points in the interaction of heredity and environment in the causation of mental illness. Particular reference will be made to schizophrenic twins.

It has been repeatedly argued, especially in the U.S.A., but most recently by Bleuler (1951), that the contribution which twin studies can make to the aetiology of mental disorder is so limited as to be negligible. The main argument put forward in favour of this view is that incidents which occur very early in the life of the individual, especially the emotional attitude shown by the mother in his infancy, must be held critical for his later development, and for laying the foundation of a predisposition to mental disorder. As uniovular twins are more alike than binovular ones, the attitude of the mother will be the same to both of a pair of uniovular twins, different to each of a pair of binovular twins. If uniovular twins are then found to be more alike than binovular twins in respect of mental illness later in life, then this is a reflection of the greater similarity in their early upbringing.

The reply which can be made to this argument is fourfold. It is not true that in early infancy uniovular twins are more alike than binovular cases; there is no evidence that mothers differentiate significantly in their emotional attitude to twins of the same sex; there is no evidence that differences in the early emotional environments of twins are related to differences in the tendency to psychotic illness in adult life; the argument itself is tendentious, and is admittedly dictated by an emotional bias.

To take the last point first: Those who advance the argument openly express the fear that, if heredity were regarded as a cause of mental illness, we should look on all such illness as predestined, and abandon hope of treating it. This is, of course, scientifically not a valid point of view to take: we should try to be guided by evidence and not by our desires. However, the fear itself is illusory. If we assign some part in the aetiology of the psychoses to heredity our enthusiasm in treatment should be unaffected. Furthermore, an examination of the facts shows that in all forms of mental illness environmental influences have to be allowed for, even if heredity also plays a part; and it should be of practical help to discover what aspects are predominantly determined by heredity, or predominantly by the environment.

To return to the factual basis of the argument: Contrary to what might be expected, there are rather greater differences at birth between uniovular than between binovular twins. There is above all a greater average difference in weight. Owing to the fact that they commonly share the same placenta and the same blood supply, uniovular twins tend to compete with one another. If one obtains a slight

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advantage, then with a more strongly acting heart it may come to get more than its fair share of the total blood supply. Binovular twins, on the other hand, are isolated from one another, and have a better chance of reaching each its own norm. At the time of birth it is more likely that the mother will tend to differentiate between members of a uniovular than between members of a same-sexed binovular pair.

The question arises whether she does in fact differentiate between twins. My series consists predominantly of adult twins, providing evidence only of a retrospective kind; more valuable information could be obtained from the current observation of infantile twins. For what it is worth, in no case in my series is there information about any sharp differentiation made by the mother between the twins. Parents, especially fathers, sometimes take a partial attitude to their children, favouring one and not the other. This partiality is much more probable with children born at different times and children of opposite sex; mothers are much less likely than fathers to react in this way. Even fathers, however, usually regard a pair of same-sexed twins in much the same way. The only likely difference to be made by the mother is in giving more personal attention to the smaller or weaker of a pair of twins, a difference, that is to say, which will be of more frequent occurrence in the first year of life in uniovular than binovular pairs.

The second point to arise is that it does not seem very likely that the psychological environment of infancy and early childhood bears much relation to the eventual development of an endogenous psychosis, such as schizophrenia. It may be a very different matter with such abnormalities as neurotic traits and psychopathic personality. In the schizophrenic twins, when the concordant are compared with the discordant uniovular pairs, there is no sign of greater similarity in the very early lives of the former than in those of the latter. A large degree of early dissimilarity may go with later concordance in respect of mental disorder.

The pair of twins in whom there was the most striking degree of early difference is a case in point. These twins, Lily and Mary, came from a psychiatrically normal family. Their father was a policeman. There were in all 11 children, our twins being the eldest, one other pair of twins dying at birth. Lily weighed 9 lb. at birth, Mary only 3½. Not unnaturally it was Mary who was breast-fed, while Lily was given the bottle. Mary was never so strong as her twin, but neither had any serious illnesses. At school they were average, but Mary won prizes. They are described as not at all alike in their ways. Mary was her dad's girl and took after him, Lily after her mother. Lily was more placid, Mary more fiery. Lily thought herself a fine lady and didn't like housework or hard work; Mary enjoyed housework and gave herself no airs. Mary would mix with anyone, Lily was too much of a madam. Both were fond of children; Mary liked animals, Lily disliked them, cats particularly. Lily hated looking after sick people and was not kind to the father, but Mary was of kinder disposition and looked after him when he was ill. Lily never liked the cold, Mary did not mind it. Both preferred men to women friends and have had many love affairs.

Both twins left home at about the age of 20, and lived thereafter together. At the same age they began to go deaf. They rather shut themselves up together, with little outside contact, and lived on very little money. They were very fond of one another, and either would be uneasy with the other away. When they were 46 Mary left her job and Lily found her another with her own firm, a caterer's. Although, unlike Lily, Mary never became psychotic to the point of requiring hospital treatment, the medical records of the firm show that at this time Mary was suffering from delusions. She had the idea that the Chief Accountant and the Assistant Chief Accountant took a passionate interest in her, and she talked of going out to dinners, dances and theatres with them. On account of these and other strange things she said she had to leave. However, she found herself other work and settled down. When she was visited eight years later she was at work and not mentally ill, but she showed some strange mannerisms, and a discrepancy of affect of a type one might expect in a post-schizophrenic patient.

Lily's illness began two years after Mary's, in 1942. She had been worried by air raids, and had lost a good deal of sleep; but the proximate cause of her breakdown was an unhappy love affair. She was found one day wandering in the courtyard of her firm. She said that inner feelings told her not to go into the office to work; she was "persecuted by men" and "all men were cads." Taken to an observation ward and to a mental hospital, it was found difficult to get in contact with her because of her deafness. Her mood was bewildered and her memory for recent events was vague. She said that voices told her "don't go in there," and that she was forced to do certain things. Delusions and hallucinations persisted, she chattered to herself, gradually went downhill into a state in which she was noisy, incoherent and unemployable, but always kept herself clean and tidy. Seen in hospital in the sixth year of her illness she was entirely inaccessible, shouting incomprehensible things which themselves showed a marked degree of schizophrenic incoherence.

Now the problem arises how the similarities and the differences in the psychotic pictures shown by Mary and by Lily are to be related to differences in their early upbringing. Is it in the least plausible to say that as Mary was breast-fed and Lily was not we can attribute to that fact the greater gravity of Lily's illness? Although the mother had a greater physical intimacy with Mary than with Lily, it was Lily who was her mother's girl, while Mary was her dad's. Both women fell ill in menopausal years, at a time when they were both suffering under a variety of stresses, the anxieties of war, employment difficulties, poor circumstances and, in the case of Lily, an unhappy love affair. Surely it is more reasonable to attribute the difference in the degree (though there is none in the quality) of their psychoses to temporally immediate rather than to temporally remote events?

The total collection of twins consisted of 297 pairs, of which 67 were uniovular and 6 of doubtful ovularity. It was possible to use the material as a whole to test some of the factors which are commonly supposed to have a predisposing influence in the causation of mental disorder. This was done by marking in each pair one as more and one as less severely affected. The members of discordant pairs who never developed a mental illness were, of course, taken as the less severely affected; but even in concordant pairs one member either had a milder illness, or became ill somewhat later in life. It was possible then to correlate differences in severity with differences in the incidence of predisposing factors. Very often the relevant information was lacking, so that for the examination of any single point many pairs of twins had to be left out of account. Enough were left to provide statistically significant information about several points.

The first factor which has to be examined is that of the birth itself. The stillbirth rate, neonatal death-rate and infantile death-rate are all higher in twins than in the singly born, largely because twins are on the average underweight, but also because twinning may cause difficulties in parturition. It is usually felt that the first-born of the twins has the more difficult passage, though I know of no conclusive statistical data. In any case among the first-born in my series there were 119 who had the more and 103 who had the less severe illness in later life. The difference, which is to the advantage of the second-born, is quite insignificant.

If, however, difficulties were known to have occurred during the birth, which was not often the case, a significant difference was found. Of those who had the more difficult birth more than twice as many (37:17) had the severer than the less severe illness later.

This is highly suggestive evidence that a minor degree of organic cerebral impairment, suffered at birth, may predispose to mental disorder. The disadvantage of those who had gone through a difficult birth was even more marked in the uniovular pairs (9:3) than in the binovular pairs (28:14). Furthermore this difference showed up in each of the four main clinical groupings, schizophrenic, affective, psychopathic and organic.

Oddly enough birth weight did not seem to be important. Those who were lighter at birth tended on the whole to do slightly better than their heavier twins. Little information was obtainable about differences in breast-feeding—as a rule either both twins or neither were breast-fed—and numbers are too small for a test.

The evidence obtained about minor physical illness was inconclusive. This is a subject to which considerable interest attaches. It may be recalled that Galton drew attention to it on the basis of his own observations of twins. He noticed that when two similar twins did develop differently it was nearly always because one of them suffered from a physical illness or accident. He wrote:

"The effect of illness . . . is great, and well deserves further consideration. It appears that the constitution of youth is not so elastic as we are apt to think, but that an attack, say of scarlet fever, leaves a permanent mark, easily to be measured by the present method of comparison" (of twins).

Much interest in this subject has recently been shown by Swedish psychiatrists. They claim to have observed mild but prolonged neurasthenic states in both adults and children after specific fevers and other physical illnesses, and even slight but semi-permanent changes of personality. To this sort of condition they have given the name "hypophrenia." More work might well be done in other countries upon this important problem. In my material I have not distinguished between the illnesses of childhood and those of later life; but taking together all sorts of illness occur-

ing well before the onset of the mental illness, it was found that of those members of twin pairs who had had more illness 44 had the graver mental state, 28 the less grave. The difference just fails to reach statistical significance.

I am not, of course, discussing here the significance of physical illness in precipitating mental illness, to which more importance attaches.

Among the predisposing causes of mental illness I should now like to mention two psychological constitutional aspects. By constitutional I do not mean necessarily genetically determined. Even with uniovular twins it is sometimes quite possible to point to one as the more and one as the less unstable or neurotic. If we confine ourselves to childhood, those who were the more neurotic at that time twice as often as not had the severer illness later on (40 : 19). The difference, however, is shown only in the binovular pairs, and so cannot be regarded as independent of genetical differences. If we take neurotic traits over the whole of the premorbid life, the difference, from one which is noteworthy and significant, becomes overwhelming. Nearly five times as often as not (72 : 15) the more neurotic had the severer illness. In the individual clinical groups the figures are schizophrenia 35 : 10, affective psychoses 6 : 2, neurotic and psychopathic states 18 : 1, organic states 3 : 2. The difference is shown just as much in the uniovular (18 : 4) as in the binovular pairs (54 : 11).

Obviously, if the uniovular pairs show this influence as much as the binovular pairs, genetical factors alone provide no satisfying explanation. Somewhere or other we must postulate the effects of environmental factors which have a double effect, first in reducing stability and giving a touch of the neurotic to the personality, secondly in prejudicing natural powers of resistance to mental illnesses such as schizophrenia.

An effort was made to classify personality differences so as to show which neurotic traits were principally at fault, and four showed up as more important than the rest : emotional lability, paranoid, unsociable and hysterical traits of personality. All these were highly significant, had their effect on schizophrenic as well as other forms of illness and, with the exception of unsociable traits, showed marked effects within the uniovular as well as within the binovular pairs.

Further than this it is not possible to go, and on the question of the nature of the environmental factors at work, physical or psychological, Freudian or Pavlovian, my guess is no better than anyone else's.

There is a second aspect of the psychological constitution which is interesting. A pair of twins of the same sex, brought up together, almost inevitably become close companions and rivals. This ambiguous relationship is not so acute in binovular twins, where there will be genetical differences leading to differences of personality, interests and activities. The more different they are the more they will tend to lead different lives, and the less acute the rivalry will be. With uniovular twins it is otherwise. They too may solve the emotional tension by choosing different paths. Lange has pointed out that one may see the gradual development of antithetical aspects of personality, even a polar difference, one, say, becoming boastful, the other shy, or one extravagant, the other economical. Relatives share in the process by emphasizing slight differences between the twins when one is compared with the other. This is a factor in the twin situation which itself leads to the development of differences, and which is stronger in uniovular than binovular pairs. Another way in which the situation may be solved is by one of the twins emerging as the dominant partner, the other as his follower. One is reminded of the interesting observations on a " pecking order " in domestic poultry, and the development of mutual dominance and submission in married couples. To a certain extent the same sort of thing, which we notice sometimes to a marked degree in uniovular twins, may develop also in binovular twins. In them too one may become relatively dominant, the other relatively submissive.

This particular trait of personality seems to be, more than other traits, susceptible to modification by environmental and psychogenic influences. Wartime experience at Sutton showed that when neurotic patients were classified by personality traits, the contrast was not so much between the dominant and submissive types as between the dominant-submissive and the independent. A man of the dominant-submissive type would tend to be dominant in one set of circumstances, submissive in another, subservient to officers, say, and domineering to men of lower rank. Whether this is true or not, the development of a general tendency to dominance or submission certainly has an influence on any mental illness which occurs.

In my material the more submissive of the two twins did conspicuously less well when assailed by either an affective or a schizophrenic psychosis. In 35 pairs the submissive twin had the more severe, in 12 pairs the less severe state. The difference was shown just as much in the uniovular pairs, though the numbers are smaller (9 : 3). In the neurotic and psychopathic pairs, however, the contrary was true. In this group submissive twins did better than their dominant partners. What is the explanation of this ?

A likely hypothesis is that the dominant one of a pair of twins develops a psychological and perhaps psychophysical constitution endowed with greater energy and assertiveness, and may thereby be better able to withstand the predominantly mentally debilitating effects of a schizophrenic illness or a depression. One might perhaps find him less well able than his more submissive partner to remain socially adjusted during an attack of hypomania—but one must remember that manic and hypomanic illnesses are much less common than depressions.

When we come to neurotics and psychopaths this extra energy of personality may not always be helpful to the subject. The Gluecks (1950), for instance, found that juvenile delinquents, when compared with a control series, were physically better built and stronger, and mentally were more energetic and aggressive. Submissiveness is an essential feature of social adaptation.

We may turn now from predisposing, and especially the pathoplastic, factors which influence mental illness to the more specific pathogenic factors. In my series there were 41 pairs of uniovular twins of which one member, the *propositus*, was schizophrenic. In 28 cases the other member of the pair was also schizophrenic. Making the fairest possible adjustment for age, the concordance figure can be calculated as 76 per cent. The concordance rate in binovular pairs was 14 per cent. Although Kallmann, on the basis of his immense material, finds a substantially higher concordance in uniovular pairs, our figures are not in conflict. My figures also agree quite well with those found previously by Luxenburger. Reviewing all the published material, including that of Essen-Möller, who found on a small series a lower rate, these investigations show beyond all reasonable doubt the great importance of heredity factors in the aetiology of schizophrenia. Those who insist on rejecting this evidence do so on grounds which convince one of nothing but their lack of open-mindedness. If we accept this evidence, that genetical aetiological factors must be ranked high, where does it lead us ? Does it lead us, for instance, to a fatalistic view, that the illness is predestined and nothing whatever can be done about it ?

Such a conclusion would be extremely superficial. Uniovular twins are to some extent a special case. The two members of the pair are alike in every one of their genes. If one becomes schizophrenic, not only must the other have any hypothetical specific schizophrenic genes, but he must have also all the other genetical constitutional factors which may have contributed to the outbreak of the disease in his partner. Even then in something like one case in four he will escape mental illness. Even against this heavy adverse genetical loading favourable factors of an environmental kind have been sufficient to protect him. It would be of the most immediate value to psychiatry if we could discover what these favourable features have been. Unfortunately history-taking proves a very blunt instrument for their exploration. Kallmann has pointed out how desirable it would be, on discovering uniovular twins of which one was and one was not schizophrenic, to admit both to hospital and carry out on both of them all the biological and laboratory tests which experience suggests might be productive.

Other workers who have interested themselves in schizophrenic twins have connected discordance, the health of one and the illness of the other, predominantly with physical differences. One twin bore children and developed a puerperal schizophrenia, while the other remained a spinster ; or one had a head injury or an infective illness which the other escaped. Very seldom has a marked difference in the psychological situation been held responsible. In my material I have one pair in which the schizophrenic twin had an attack of meningitis at the age of 4 which the healthy twin escaped, and another pair in which both twins had congenital syphilis, but the twin who had earlier treatment remained well while her partner became schizophrenic. In yet another pair the eventually schizophrenic twin was a heavier beer-drinker than his brother. I have one pair only in which there was a marked degree of difference in the psychological situation.

These were a pair of Austrian girls, Poldi and Friedel. Birth was normal and both were healthy as children, but Poldi was always the heavier and stronger. Nevertheless they were extremely alike and were often mistaken for one another. They were brought up in a Catholic nunnery school and were equally forward, but Poldi had more ambition and learned better. They were much alike in character and were extremely fond of one another, but Friedel was more dreamy and romantic. She was fond of reading and writing and once composed a film scenario. She did not make friends so readily as Poldi, and was less ready to trust herself, or others. However, she had no nervous symptoms till her illness. The two girls came to England from Austria together in 1935, then being 24, and took positions in families. Poldi was very happy and was treated like one of the family. Friedel was less fortunate. Her mistress was nervous and hysterical, and was always having rows with Friedel or her husband or her servant. She told Friedel she was just an ordinary maid and must not give herself airs over music. Her husband was a little kinder. At last there was such a scene that Friedel gave in her notice. Poldi went to see her and found her excited but normal. Two days later, however, she had been admitted to a mental hospital. Some months later Poldi returned to Austria, and such evidence as we have shows she has remained well. Friedel, however, never fully recovered from her initial acute catatonic state, and is at the present time deteriorated, manneristic, foolish and impulsively destructive.

The evidence suggests that the chance whether a predisposed person is or is not subjected to a physical or psychological stress may be critical for his later career. I would not like to exclude the possibility of psychoses of schizophrenic type of purely environmental causation, but would imagine that they are rare. In the majority of schizophrenic psychoses the heredity predisposition has probably played an essential role. Those without this hereditary factor would therefore be practically immune to the disease. This is essentially a much more optimistic view than that of American environmentalists, who would regard us all as equally liable to schizophrenia. Having the predisposition, however, one will not develop the disease unless other factors, environmental and genetical, conspire against one. If an effective environmental stimulus is applied, then the disease begins, but without that stimulus one may escape for good. Furthermore, the evidence suggests that once the disease has started it will progress or remit in a way that is decided mainly by factors which have nothing to do with heredity. The ultimate outcome shows no close resemblance within uniovular pairs, and other workers, such as Bleuler, have found that it is not often similar within pairs of sibs or other relatives. These ideas lead one to emphasize strongly the significance of precipitation and the importance of treatment.

A pair which illustrates the significance of certain possible precipitants, and also shows the very great difference in age of onset which may exist, is that of two twins, one of whom fell ill at 16 while the other remained well until 49.

In this case there is a family history of mental illness. The father was extremely religious and strict in his views. One of the brothers started to have epileptic fits at the age of 13, and at 25 was picked up when wandering in a confused state and taken to a mental hospital. His state in hospital seems to have been a prolonged epileptic twilight state which took some months to recover.

The two twins were girls, Connie and Ada. When they were children they were so alike that the teachers had to ask who was who. Connie was more mischievous as a child but in later years was quieter, and then also differed a little physically, being rather more of a pyknic habitus. Connie was also of a more sensitive disposition than her twin, and was more given to worrying. She was much upset when Ada left home to work, and still more so when her mother died. She was then 16. Very gradually after that her behaviour became more and more peculiar, and she took to wandering away from the house and would be found by the police in distant spots. When she was admitted to a mental hospital at the age of 27 her illness was said to have already lasted 8 years.

On admission to hospital she was depressed. She spoke vaguely of mysteries connected with her illness and of influences controlling her. She grimaced and her gesticulation was odd. At times it was clear that she heard hallucinatory voices, and she then became restless and excited; but as a rule she was dull and slow. In the course of years she became more and more withdrawn, mute, vacant, even stuporose. The hebephrenic picture took on some catatonic features.

Ada went out to work instead of staying at home like Connie. She did well and became forewoman at a printing works, but continued to live at home with her father, a quiet, respectable woman. Her father died when she was 49, and though she then moved into a flat on her own and seemed to settle down she gradually became more and more peculiar. She had difficulty in keeping jobs and had an increasing number of disputes with her neighbours. She told others that she was followed around in the streets by a man in a mackintosh, and that she could see "lights." She gave up work entirely, neglected her appearance, would throw water down the stairs in the early hours of the morning and threw milk bottles

out of the window. Eventually a flying milk bottle struck a passer-by in the street and the police forced an entry into her apartment. She was admitted to a mental ward at the age of 55, twenty-eight years after her twin.

In hospital she said she could see traffic lights and posts with cross-arms travelling about the room; she was pursued by police in cars and aeroplanes; she heard voices saying "crafty old thing"; she was "intimidated for lantern-slides" and heard remarks about television. She showed herself an angry paraphrenic. Gradually in the course of years her behaviour deteriorated and she became as incoherent and inaccessible as her sister.

The similarities and differences in this pair of twins are instructive. There is a suggestion of psychogenesis in each of them, the one starting to go downhill after the loss of her mother, the other after the death of her father. The onset in one is associated with the endocrine and emotional changes of adolescence, in the other with those of the menopause. The one has an insidious hebephrenic psychosis, the other a more stormy paranoid psychosis. The final state of each is the same.

Another instructive case is that of Barbara and Ellen, girls of rather dull intelligence who went into domestic service after leaving school. Ellen is said to have contracted syphilis at 25, but she was treated and discharged cured. At some time after that she was put on probation for annoying a clergyman. At 29 she showed the first signs of mental disorder when she had been working very hard, and was admitted to an observation ward. There she said she could hear the voice of Christ Jesus telling her to be a good girl; the voice came through the window. The doctor had put electricity on her head. She had written letters to the vicar as she loved him. Transferred to a mental hospital, she continued to hear the voice of Jesus, and would preach to those around telling them how wicked they were. Within a few weeks she ceased to be hallucinated, settled down to an orderly life and was a willing worker. She remained like this for the next 11 years, without deterioration, but with occasional attacks of excitement, usually caused by a fracas in the ward. When I saw her in 1937 she was still in the mental hospital, but seemed to me to have made a complete recovery. Affective *rappport* was normal. She was willing to discuss her past delusional and hallucinatory experiences, said she had long been free from them, and put them down to mental illness. The next year she was discharged to mental after-care, and after that got a job. In 1948 the mistress who had employed her for the past five years reported she had been well all that time.

Barbara, who had also gone into domestic work, after a time gave it up and worked in a factory. Like Ellen, with whom she had little contact, she became interested in religion. At one time she assumed the name of a local Canon, and called herself Mrs. R—. She is said to have caused clergymen in her neighbourhood some annoyance, but she did not fall ill until 1947, twenty years after her twin. She then became depressed and quiet, and one day was found looking "vacant and mad" and saying that she was going to marry the parson and would next day be dead. In the observation ward she was depressed, restless, suspicious, aggressive and auditorily hallucinated. In the mental hospital she refused to answer questions, saying it was none of her doctor's business. She pointed to veins in her leg, saying that that was where "they" injected the Indian drug. Asked who "they" were, she replied, "Bear my cross, it doesn't matter." Three months after admission she was becoming more grandiose. She said she was a queen, married to the Bishop of Birmingham. She had had 26 children since she had been in hospital, having got the man's seed in a cup of spirits of salt. When I saw her in 1948 Barbara was still showing a florid paranoid picture, and talked in even and equable tones in an incoherent grandiose and bizarrely paranoid way. The flight of ideas recalled a manic state, but her manner was haughty and resentful as that of a woman who has been insulted.

The striking points about this pair are, on the one hand the considerable symptomatic resemblance in the clinical picture, on the other hand the great disparity in age of onset, and the great difference in outcome. Rather surprisingly, it is the psychosis that comes on late in life which proves much the more malignant.

One is constantly meeting such mixtures of similarities and dissimilarities in twin material, and it is not often possible to find much rhyme or reason behind it. Statistical analysis helps a little. In certain sorts of symptoms twins and other blood relatives tend to resemble one another, and in other types of symptom they do not. My case-material is rather old, and case-notes were nothing like as good in mental hospitals when the work began as they are to-day.

To take such a symptom as depersonalization, for instance. This is a rather unusual but far from rare symptom, of more than common interest. What medical officer, however, would pay it the slightest interest in the old days? It was enough for his purpose to write down the symptoms which proved the patient to be indisputably mad. Yet I have two pairs, one uniovular and one binovular, of which both members complained specifically of this symptom. Taking symptoms as a whole,

there was a greater degree of resemblance between twins in respect of positive symptoms than negative ones. A depressive or manic colouring, for instance, can be regarded as a positive affective symptom, and both twins and other sorts of relative tended to resemble one another in showing or not showing such affective change. Flattening, and inappropriateness of affect, however, can be regarded as negative symptoms, and there was little resemblance between relatives here. This is all to be considered in relation with the point I have already mentioned—that the outcome of the illness and the degree of schizophrenic deterioration do not seem to be caused by hereditary factors.

Finally there is one more point I would like to mention—the difficulties of diagnosis which constantly face us. Some psychiatrists pour scorn on diagnosis, regarding it as entirely secondary in importance to psychodynamic study of the personality. I am sure that when we are dealing with the psychotic patient this is a mistaken view. The conclusion we reach about the nature of the illness from which he suffers, whether it is organic or functional, endogenous or reactive, schizophrenic, affective or epileptic, provides the fundamental basis of prognosis and treatment. In one discordant pair of uniovular twins the patient during her stay in the mental hospital was regarded as a schizophrenic. Yet I have now, never having seen her myself, no hesitation in retrospectively revising the diagnosis.

These twins are described as "alike as two peas"; they were of the same build, colouring and facial appearance and could even wear each other's spectacles. Pamela has never had any nervous symptom of any kind, and was still healthy and normal when last seen at the age of 29. Beatrice first became nervous at 13, when she developed a fear of going to bed at night. She had done extremely well at school, and was advanced two classes on returning to school from the holidays. However, she had a breakdown, and was admitted first to a general and then to a neurological hospital. While in hospital she had a violent attack, which was not considered to be epileptic. She returned home, but became worse and was admitted to a mental hospital. There she was sullen and had fits of biting herself. She tried to swallow safety-pins, coins and pencils, and she spoke of monsters looking through the windows. Consciousness was clouded and her conversation was incoherent. She recovered and went home, but soon had first a mild and then a severe relapse, in which she tried to strangle herself and to throw herself into the canal. In hospital again she would sit and stare, or scream, bite her arms and beat her head and limbs on the floor. She was thought to be hysterical. For some time after that she was quiet and inaccessible; but she would also have hallucinated phases in which she was violent. Once more she recovered to return to school. Before she was 16 she relapsed again with a twitching in one arm. Admitted to a neurological hospital, she was thought to be suffering from chorea. Once more she went into a state of hallucinosis and violence and was transferred to a mental hospital, where attacks of clonic spasm of the muscles succeeded one another. Once again she made a complete recovery after a few weeks. Some months after recovery she attended a psychiatric clinic, where intelligence tests showed a superior intelligence but marked scatter, or irregularity of performance, suggesting an organic change. She was, however, regarded as suffering from hysteria and was treated by psychotherapy. She tried clerical work but did not do well, and became a probationer nurse. At the age of 20 her symptoms returned. She started to have shaking fits, and then passed into a state of panic terror in which she was admitted again to a mental hospital. Further attacks of violence occurred, and she was thought to be a case of Gjessing's periodic catatonia. In lucid intervals she was rational but had an affected manner. She completely recovered and was discharged. She worked as a telephonist for two years, but then had to return to hospital for attacks of violence and attempted suicide. Then, for the first time, she had a series of major epileptic attacks, culminating in *status epilepticus*, with 60 fits in 24 hours. Her life was saved by treatment, but her doctors still did not think of her as an epileptic. Describing her own feelings, she said that a queer feeling came over her in which she felt she "must do something"; she felt then as if she were in another world; everything was confused and she saw flashes of light, dark patches, kaleidoscopic colours—"indescribable." She was given insulin treatment, which was, however, interrupted when she had another major fit. Once more she recovered, but relapsed again, sometimes smashing windows, or trying to injure herself (she bit off the terminal phalanx of one finger) or having an occasional epileptic fit. At the age of 26 she was subjected to prefrontal leucotomy, and she then improved much, becoming cheerful and rational though somewhat fatuous. She went home, but a year later she became depressed, smashed windows, and was taken to hospital, where she shortly died in *status epilepticus*.

I think that there can be no reasonable doubt that all this girl's recurrent short-lived psychotic phases were epileptic twilight states. Despite many characteristic features, especially her own description of her subjective feelings, and despite the occurrence of major epileptic fits, every diagnosis but that of epilepsy was made,

and every treatment given but the appropriate medication. Gruhle has pointed out that the psychotic states of epileptics are often phenomenologically indistinguishable from schizophrenia. Epileptic fits of an occasional kind are often observed in chronic schizophrenics, especially catatonics, without doubt being aroused of the diagnosis of schizophrenia. We should perhaps be more alert than we are to the possibility of simulation of a schizophrenic state by an epileptic one.

I hope that from the sketch I have provided it will be seen how twin investigations can take us some if only a little way into the problems of aetiology. Certain broad indications emerge, but conclusive answers to precise questions of detail are not to be obtained. There is, for instance, a good deal to indicate the significance of endocrine factors, but none at all to show which aspect of endocrine metabolism is worth special investigation. This is because the data with which I worked had not been subjected to special lines of inquiry, and not because of a weakness in the twin method of investigation. It would be perfectly possible to pursue the same method with much more precision and power on material which had been carefully investigated along either biological or psychologically analytical lines.

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A COMPARISON OF THE PERSONALITY CHANGES AFTER (1) PRE-FRONTAL SELECTIVE SURGERY FOR THE RELIEF OF INTRACTABLE PAIN AND FOR THE TREATMENT OF MENTAL CASES; (2) CINGULECTOMY AND TOPECTOMY.

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INTRODUCTION.

EXTENSIVE lesions of the frontal lobes are followed by pronounced personality changes. This has been shown beyond doubt by the effect of neuro-surgery performed for the removal of brain tumours or for the relief of mental illness. To identify such changes and the lesions responsible for them at least four conditions seem necessary :

(A) *Knowledge of the limits, variations and connections of the main pre-frontal areas.*—In this field the researches of Professor Alfred Meyer and his associates, Mrs. Beck and T. McLardy, are of primary importance (1950).

(B) *Relatively normal patients.*—The results with chronic or deteriorated psychotics do not lend themselves to reliable objective analysis (Crown, 1951). In contrast, intractable pain patients or neurotics—reported on in this paper—appear to present much more meaningful information regarding frontal lobe function.

(C) *Selective prefrontal operations.*—These can now be achieved with the open techniques. Careful post-operative radiological assessments of the limits of the section or excision, on a large number of patients, yield satisfactory anatomical information, with reasonable certainty.

(D) *Knowledge of the dimensions of personality, along which psychological measurement can be made; and objective psychological tests to carry out such measurements sufficiently sensitive to register changes caused by frontal lesions.*—In this field the work of Eysenck and his associates (1947, 1952) and Cattell (1950)—on personality tests related to the factors that have so far been identified—is of particular importance.

The consistent personality changes—as measured by objective psychological tests—following on different types of prefrontal operations are described in a recent publication (Petrie, 1952b). The important differences in the effect of the various techniques is also noted. These operations were carried out on patients in England by Mr. McKissock. In this paper the effects of two other selective operations are presented and compared. These were topectomy of the convexity and cingulectomy performed by one of us (J.L.B.) on French patients.

On the basis of the results of leucotomy on English patients referred to above (1952b) and the observed clinical effects of these two new operations the following hypotheses were postulated :

(1) Changes in temperament and character after Le Beau's *convexity* operation would be of the same basic pattern as that found after the different operations already studied in England.

(2) The extent of the personality changes would be smaller after the French operation than after the English Rostral, as the former is more circumscribed.

(3) The loss on intellectual tests found after the Standard operation in England would not be present following on the circumscribed operation in France.*

* The French *convexity* operation involves primarily area 9 and 10 and is even more circumscribed than Mr. McKissock's Rostral, which also did not cause a loss on intellectual tests.

(4) After operations carried out for the relief of intractable pain, personality changes would be of the same pattern as those found after operating in the treatment of severe neurosis.

(5) Whilst a similar pattern of personality changes would result from all lesions in the granular cortex, a new pattern of changes might emerge after a lesion which did *not* affect the granular cortex—that is, after cingulectomy.

The results on the 35 patients examined before and after operations carried out by one of us lend support to these hypotheses.

THE OPERATIONS.

The operations are of three types: (a) convexity, (b) cingulectomy, (c) mesial undercutting. They are all bilateral. All the patients were operated upon by one of us (J.L.B.) in Paris since 1947. Detailed psychological testing was started there in 1950. The psychological techniques were designed, the psychological testers trained and the results analysed in London.

(a) *The Convexity Operation.*

This is the original topectomy as practised by Pool in New York in 1946 (Le Beau *et al.*, (1950)). The only important difference is that his patients are mostly psychotic, while our own population is richer in neurotic and pain cases. The operation is well known now and there is no need to describe it again. Only the following points need be stressed:

1. Either area 9, or area 10, or both are involved. Sometimes a part of the orbital surface (area 11) is encroached upon, but the operation never goes as far back as area 8. (For the meaning of Brodmann's numbers and the advantages of using them see Le Beau (1951).

2. Either topectomy (cortical resection) or subcortical undercutting (Scoville's technique) was used. Topectomy was performed by excising the cortex and its arteries, or by a type of subpial dissection (decortication) which avoids the arteries and thus is possibly more selective. Sub-cortical undercutting, when involving both areas 9 and 10, is similar to McKissock's Rostral leucotomy, although it does not cut as much on the orbital surface nor in the region of areas 9/8; its lateral extension also seems to be smaller.

3. Therapeutic results after a period of one to five years have been published previously (Le Beau, 1950a). It is only necessary to repeat that the convexity operation seems especially successful in anxiety neurosis and many kinds of intractable pain. From the evidence collected to date the patients are not noticeably incapacitated socially by the operation.

4. A detailed study of the immediate post-operative syndrome was recently published (Le Beau, 1952). Typically it is a hypomanic state with the euphoria, joking tendency, sphincter disturbances and general carelessness of the classical "frontal" syndrome. This appears to be related more to the suppression of area 9 than of area 10, but particularly noticeable is the pronounced contrast between this "convexity" syndrome and the "mesial" syndrome, described below.

90 patients were submitted to the convexity operation since 1947 and clinically studied. Of these, 70 were topectomies and 20 were under-cuttings.

(b) *Anterior Cingulectomy.*

The operation was first performed in 1948 with the definite purpose of quietening the states of anger, agitation and violence, which were apparently unrelated to anxiety. Its technique and results were described eighteen months later (Le Beau *et al.*, 1949) and again in considerable detail by the same authors in 1950. Then the results of cingulectomy in epilepsy with character disorders were reported (Le Beau, 1950b); and, by the same author, its effects in psychosis and in obsessive states (1951), and finally a detailed study of the post-operative syndrome (1952). The following points seem important enough to be re-stated:

- (1) Usually area 24 is removed, just above and in front of the anterior part of the corpus callosum. Often area 32 is involved, sometimes area 12 situated under 32, rarely area 25 under the genu of the corpus callosum.

- (2) Technically it is a decortication avoiding the arteries; and as both left

and right areas are removed with a unilateral approach the veins of only one side need be interrupted. Thus the operation is really selective.

(3) Long term therapeutic results show the effectiveness of the operation in the above-mentioned conditions, with the exception of chronic psychosis such as schizophrenia, where it fails. One of its chief advantages is the apparent absence of undesirable mental effects, in comparison with the other operations.

(4) The post-operative syndrome during the first few days is apparently free from the indifference and euphoria caused by the convexity operation. Usually there is little to note, except, on occasion, some apathy or even some slight agitation. In general, the patient appears to be much more "himself" than after any other pre-frontal operation.

This operation has been performed on occasion in the U.S.A. (Pool, 1947, and Ward 1948), but the only other detailed report we know of has just been published in England (Whitty *et al.*, 1952). The welcome article of the Oxford workers confirms almost all that we published previously (Le Beau *et al.*, 1950). Three differences between their work and our own are, however, noticeable; the operation was not tried on epileptics with character disorders; it was often used in schizophrenic states where we prefer mesial undercutting; and they report that it reduces anxiety, while we believe its value lies in its other effects, described above.

Thirty cingulectomies have been performed by one of us (J.L.B.) and clinically studied since 1948.

(c) *Mesial Undercutting.*

This type of mesial operation follows Scoville's technique, with some differences:

(1) Areas 32, 24 and often 12 are undercut, which necessitates undercutting in addition either the mesial part of 9 or 10 or both. Although the operation is thus less extensive than the complete mesial undercutting, it is far less selective than cingulectomy, since it always involves some part of the convexity.

(2) In order to be selective, as few arteries and veins as possible, on both the left and right convexities, should be damaged.

(3) Results seem specially good in obsessive compulsive neurosis. In schizophrenia with aggressive tendencies the operation often needs to be completed by a convexity undercutting (Le Beau, 1951).*

(4) The post-operative syndrome may exhibit some of the features of the convexity cases, chiefly when the cut goes through area 9 rather than 10; apathy and incontinence seem to follow an orbital extension of the mesial cut (Le Beau, 1952).

15 cases have been submitted to the mesial undercutting operation since 1948. All were clinically studied before and after the operation.

PATIENTS WHO WERE INVESTIGATED BY PSYCHOLOGICAL TECHNIQUES.

The psychological changes in respect to 34 patients are detailed below.

18 patients underwent convexity operations; 10 of these were suffering from intractable pain and 8 were mental cases. (9 of these patients with convexity operations had undergone topectomy and 9 were subjected to subcortical undercutting.)

10 patients were subjected to cingulectomy. All but two of these were epileptics.

In addition, six patients were examined who had mesial undercutting which anatomically falls midway between cingulectomy and the convexity operations. Three of these were pain cases, three were mental cases.

PSYCHOLOGICAL TECHNIQUES.

Two French psychological testers—Mrs. Namin and Mrs. Stewart—were trained by one of the writers (A.P.) to carry out in Hôpital Lariboisière the investigations

* We have recently heard of a series of mesial undercutting operations performed on deteriorated mental patients by Livingstone of Portland, Oregon, U.S.A. (1952). Although results are not yet published we understand that, therapeutically, they are considered to be satisfactory.

identical with those found fruitful in England. The same method of administration was retained in order to make possible comparisons of the two sets of results.

Patients were examined shortly before and one to four weeks after the operation. A third examination was carried out six to eight weeks after the operation. The changes shown at this third examination in comparison with the pre-operative condition are reported in the results. Reference may be made, however, to the results of the fourth investigation—which has already been carried out on some of the patients, after an interval of 7 to 9 months—as providing confirmatory evidence of the changes reported.

The second investigation was purposely carried out as soon as possible after the lesion in order to try and obtain an idea of what might be happening before adaptation to the deficit occurred. From the therapeutic aspect we are, however, chiefly interested in the more permanent alterations in the patients presented at the later investigations—which we have been able to show persists after an interval of months and years (Petrie, 1949*b*, 1952*a*).

The personality tests were chosen to include five variables related to the factor of "neuroticism" and five variables related to the factor of "introversion." Among these were tests of suggestibility, manual dexterity, self-criticism, perseveration, speed of writing, self-blame, attitudes to time, appreciation of humour and the preference for accuracy or speed. In addition, estimates of intervals of time were obtained. The intelligence tests used were Wechsler-Bellevue Form II, Verbal and Performance Scale and Porteus Mazes.

The difference between pre-operative and post-operative scores has been calculated in each case. For the small sub-groups predictions were made—on the basis of hypotheses 1 to 5 presented above—as to the direction of the change on all the relevant variables. The Binomial Test was used to ascertain the significance of the changes found. Further, in order to measure the significance of the changes on the individual personality tests, Lord's modified "t" test was used (1947).^{*} The level of significance used throughout is that the probability is less than 1 in 20 that such a change would have occurred by chance.

RESULTS OF THE PSYCHOLOGICAL INVESTIGATIONS.

a. i. *Convexity Patients* (Areas 9 and 10).

18 patients have been examined who were subjected to convexity operations, involving areas 9 and 10. All five variables related to "neuroticism," and all five variables related to "introversion" changed in the predicted direction. The changes were highly significant according to the Binomial Test (less than .01). The post-operative personality changes after Le Beau's convexity operations are thus of the same basic pattern as that found after the English operation. The individual test changes on the 18 French convexity patients do not, however, reach the level of significance, whilst on the 15 English Rostral patients the changes are significant on each of the ten variables. The mean changes are, in fact, less pronounced after the less extensive French operation than after the more extensive English operation.^{*}

On the intellectual tests improvement is shown on both the Performance and Verbal scale of the Wechsler, though it is, as expected, more pronounced on the former (Petrie, 1949*a*). Porteus Mazes also shows some improvement. Thus, the circumscribed French operation differs from the Standard English in its effects on the intellect in that no loss was shown on the intelligence tests used. In this it is the same as Mr. McKissock's Rostral operation, which also caused no loss on these intelligence tests (Petrie, 1952*b*).

^{*} In calculating the significance of the changes on the individual personality tests after prefrontal lesions a one-tailed test was used. This was based on the seventy patients—already examined after such lesions—having demonstrated clearly and consistently the direction of these changes (Petrie, 1948, 1949*c*, 1950, 1951, 1952*a*).

^{*} These results, in addition to confirming the hypothesis of the direct relationship between the extent of the lesion and that of the personality changes, are of further interest. If there was any basis to the supposition that practice effects are mainly responsible for the changes found, then the greater the number of investigations, the more pronounced should be these changes. We have found the contrary to be true. These French patients were examined four times, the English Rostral patients only twice; nevertheless the English patients showed the greater change.

a. ii. *Convexity operations carried out for the treatment of intractable pain.* (Areas 9 and 10.)

The changes in ten patients who underwent a convexity operation for the relief of intractable pain were examined separately.

Approximately two months after the operation the clinical condition of four of these patients was considered to be greatly improved. There was some improvement in five more, whilst there was no change in the condition of one of the patients.

On all ten personality variables the pain patients showed changes in the predicted direction. This is highly significant according to the Binomial test (less than .01). Two of the test changes were significant when taken on their own; these were the decrease in suggestibility and in perseverance.

On the intellectual tests there was greater improvement on the Performance scale than on the Verbal scale. The total improvement on the complete Wechsler reached the level of significance. There were also higher scores on Porteus Mazes.

It would thus appear that patients with convexity operations for the relief of intractable pain show the same pattern of changes as that found in neurotics with the same lesions. Perhaps this provides some evidence in favour of the changes described being the basic pattern in man when the frontal lobes are no longer intact. It enables us, in any case, to argue from the effect of these operations on neurotic patients, as to what may be happening to patients suffering from intractable pain after these lesions.

a. iii. *Convexity operations with lesions in Brodmann's area 10.*

The changes in nine patients using the convexity operation involving area 10 only were examined separately. It was found that all ten variables were changed in the predicted direction and that the changes were highly significant according to the Binomial test. (Probability less than .01.) Four individual test changes reached the level of significance when taken on their own. These were decreased suggestibility, increased speed of writing, decreased perseveration, and increased speed in a series of trials at a task of manual dexterity. It is worth noting that three out of these four changes are on variables related to "neuroticism," whilst only one is related to increased "extraversion." This fits in well with Le Beau's observation suggesting that area 9 as opposed to 10 appears to be mainly responsible for the increased extraverted behaviour of the patients. With a sample of this size we can, however, only point to the suggestive nature of these findings.

b. *Anterior Cingulectomy.* (Area 24.)

Ten patients were subjected to anterior cingulectomy. This primarily involves area 24 and does *not* affect the granular cortex. On the five variables related to "neuroticism" the changes were inconsistent and the picture unclear; on two variables they were in different directions on the third and fourth re-test. One change increased significantly; this was the top score of a series of trials in a test of manual dexterity.

With regard to the five variables related to diminished "introversion" four changes were in the *opposite* direction to that of all the convexity operations. One of these—the *decrease* in the number of mistakes on a series of trials of manual dexterity—was highly significant.

A significant *improvement* in Verbal I.Q. was found after cingulectomy. This is another difference between its effects and that of lesions in the convexity.

It will be noted that the whole pattern of change is atypical in comparison with that after all the convexity operations. The most noticeable difference, however, is that there is *no* indication of increased extraversion. This fits in well with the clinical impressions reported above.

Owing to the smallness of the group, there can be no certainty that it constitutes a representative sample of a larger population; the findings must, therefore, be regarded as not necessarily conclusive. It is, nevertheless, surprising that after having had consistent pattern of changes with four small groups who had undergone convexity operations in France, and four groups with different convexity operations in England (Petrie, 1952b), the cingulectomy group should be an exception. It may well be that these results are, therefore, a pointer that the changes found after lesions in the prefrontal cortex are specific to this area.

c. *Mesial Undercutting*. (Brodmann's Areas 9, 10, 24 and 32.)

This is an operation involving both the convexity and the anterior cingulate. Hence one would expect the changes to be a combination of the effect of the convexity and cingulectomy operation. This was confirmed by our impression of the six patients operated by this technique. The pattern was suggestive of an effect midway between the clear alterations following on a pre-frontal lesion and the somewhat contradictory and inconsistent changes after cingulectomy.

DISCUSSION.

The results of all the different convexity operations indicate the consistency of the pattern of changes caused by these incisions, and the agreement of this pattern with that in the patients previously examined in England. As was suggested after comparing the operations in England, the extent of the operation appears to be directly related to the extent of change—the least extensive operation causing least change (Petrie, 1952b). Perhaps of even greater importance is the confirmation that the same pattern of changes occurs after convexity operations performed for the relief of intractable pain as after those carried out for the treatment of severe neuroticism.

All these convexity operations result in changes on five variables in the direction of a decrease in the factor of "neuroticism" and on five variables in the direction of a decrease in the factor of "introversion," so that such a patient is less suggestive, less self-critical, less perseverating in motor tasks, and his top score in a series of trials at a test of manual dexterity has improved. He shows a tendency to blame the environment rather than himself; a pre-occupation with the present rather than the past—or the future; an increased liking for sex humour; a preference for speed rather than for accuracy; and a decrease in the ratio of his verbal to performance intelligence.

The results have also confirmed that when the operation is limited primarily to Brodmann's areas 9 and 10, the loss on tests of intelligence—present after a more extensive operation, such as the Standard (Petrie, 1952b) fail to occur. The alterations in personality of the cingulectomy patients are suggestive that these changes are specific to lesions in the pre-frontal region—or, more precisely, in the granular cortex; for although the same pattern of changes appears after seven different types of pre-frontal operation, a different picture is presented after cingulectomy. These findings are supported by clinical impressions based on many more patients. The cingulectomy cases do behave differently from the others. This is not surprising as the granular cortex is an entity, and if it is not involved one would expect to find different effects on personality. It is also noteworthy that this is probably one of the first occasions in which the lateral areas have not been involved in such an operation, and that cingulectomy affects a smaller area than most other frontal operations.

It is, however, necessary to point out that the group of cingulate patients differed from the other patients on two variables besides the type of incision. The majority were epileptics and they were of lower intelligence than the others. We have no reason to believe from the previous work carried out with epileptics that they would respond differently from other patients to the personality tests included in this battery (Davies Eysenck, 1950 and 1952). Their average score lies somewhere between that of a neurotic and a normal population. It is difficult to estimate to what extent their low intelligence may be influencing the results. It is interesting, however, to note that there is a relationship between the clinical impression of the convexity operation causing increased extraversion—which is not the case after cingulectomy—and our findings on objective tests that there is a clear-cut change towards the extraverted end of the scale after convexity operations, but not after cingulectomy.

The changes found at the third investigation have been reported after all the convexity operations. These results were supported by the fourth re-test, although this has only been carried out to date on some of the patients. Only in the case of the cingulectomy patients did the third and fourth re-test changes appear to go in opposite directions, thus adding to the atypical pattern after this operation.

The second investigation—that is the first post-operative—carried out from one to four weeks after the operation, did not present consistent results in any of the groups. On more than half the variables the change appeared to go in the opposite

direction to that which it showed later. We are presumably measuring the effect of the traumatic shock of the lesion in addition to the deficit the lesion has caused. This may be a hint that the original effect of the deficit is not consistent; what is consistent is the adaptation made to it. It has been reported that—from the clinical viewpoint—the immediate post-operative syndrome seems to bear no relationship to the long-term therapeutic results (Le Beau, 1951).

A detailed clinical study of intractable pain patients has demonstrated that a great improvement in their condition after the operation is compatible with very good social adjustment (Gaches, 1952). The circumscribed incisions carried out on these patients have now also been shown—on objective tests—to be followed by the least change of all the operations so far studied. With regard to the identity of the pattern of changes in the intractable pain patients and the neurotic patients it will be realized that some of the pain cases may, in fact, have been neurotic. Nevertheless, the personality change has caused an alteration in their attitude towards pain; and the nature of this change in personality is predictable from our findings on neurotics.

Numerous researches have demonstrated that whilst leucotomy can alleviate the condition of patients suffering from intractable pain—as is reported in this paper—it does not achieve this result by raising the threshold to pain sensitivity (Chapman *et al.*, 1948; Fleming, 1950). In a recent publication it was suggested that some of the objective changes in personality found in neurotic patients after leucotomy may be contributory factors to the effect of this operation on pain patients (Petrie, 1952b). The point was made that the patient's increased orientation to the present, as opposed to the past and future, and his reports indicating that time was passing more quickly after the operation, might be related to the change in his attitude to pain.

If as a result of the change in attitude to time the patient is less concerned with the pain that may be coming and the pain that has passed, he is primarily contending with the present pain on its own. It is not possible to estimate how much this shrinkage in the range of interests in time makes the total situation more bearable; but it appears reasonable to suggest that it may be contributing to this effect. It is tempting to speculate whether the effect of the change in the patient's estimate of the passage of time is the obverse of that in a situation in which time appears to be passing more slowly than usual. In the ten minutes between the alarm clock ringing and the arrival of the early morning cup of tea, time can be subjectively stretched to contain a dream covering 24 hours of agony and fear. To many of us such a dream day may be more unpleasant than ten minutes of actual agony and fear. When time, instead of being stretched, contracts as it seems to do after frontal lobe lesions, the contrary might be true. To some extent the suffering might become more bearable. In any case, the pain patients in this series showed changes in these directions: they were more orientated to the present, and their estimate of time changed in a manner suggesting that time was passing more quickly for them.*

In addition to these two changes, it is noteworthy that after operations which are successful in such cases, the patients show a pronounced decrease in suggestibility. If an individual becomes, for example, less suggestible to the idea that an article he is touching is hot, he might perhaps be less suggestible also to the idea that a sensation he is feeling is painful. It is not suggested that these objective changes are anything but contributory to the effect of this operation on patients with intractable pain. It would, however, seem desirable to explore further the impact of this type of change on attitude to a painful situation.

SUMMARY.

1. Various selective frontal operations carried out in France are described. These include convexity incisions (Brodmann's area 9 and 10) and cingulectomy (areas 24 and 32).

2. Brief reports of therapeutic results with different groups of patients are presented.

* Investigations as to increased distractibility and less vivid imagery have not, as yet, been carried out on patients suffering from intractable pain. It was, therefore, not possible to obtain evidence in support of the suggestion that such changes—found in neurotic patients after these operations—were also related to the alteration in pain attitude (Petrie, 1952b).

3. 34 of the patients were examined on a group of objective psychological tests before and on three separate occasions after the operations.

4. The pattern of changes in temperament and character found in 17 patients who had undergone selective convexity operations is the same as that found in patients after leucotomies carried out in England. The changes indicate a decrease on five variables related to "neuroticism" and a decrease on five variables related to "introversion."

5. The extent of the changes was less after the French operation than after the English operation. The former are also more circumscribed.

6. The loss on intellectual tests found after the Standard operation in England was not present following on the circumscribed operations in France.

7. The pattern of changes on the ten variables was the same in patients operated on for the relief of intractable pain as in those operated for the treatment of mental illness.

8. Whilst the same pattern of changes on the ten variables occurred after all the convexity operations involving the granular cortex, a different pattern emerged after anterior cingulectomy involving the cingulate area. This, in combination with the clinical effects of cingulectomy, provides suggestive evidence that the changes found after the convexity operations are specific to the granular cortex of the pre-frontal areas.

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PSYCHOSOMATIC ASPECTS OF THE PREMENSTRUAL TENSION SYNDROME.

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A. INTRODUCTION.

THE term "premenstrual tension" was applied by Frank (1931) to a syndrome developing during the second half of the menstrual cycle and clearing up soon after the onset of the menses.

The syndrome consists of nervous tension, irritability, anxiety, depression, bloated feelings of abdomen, swelling of fingers and legs, tightness and itching of the skin, headaches, dizziness and palpitations. Less commonly there occur hypersomnia, excessive thirst and appetite, increased sex desire, and in some affected subjects an increased tendency for asthma, migraine, vasomotor rhinitis, urticaria and epilepsy.

The condition must not be confused with the premenstrual discomfort that many women experience without significant disability. The premenstrual tension syndrome may seriously interfere with work and social activities and can be incapacitating.

The aetiology of the condition remains obscure. A number of theories have been postulated implicating hormonal, physiological and biochemical changes, which will be discussed in more detail later.

A number of authors stress the importance of psychogenic factors. Hoffman (1944), reviewing the literature, concludes that an unstable nervous system may be the primary factor in the condition. The precise role of psychogenic factors in premenstrual tension has not yet been elucidated, and the present investigation was instituted with the aim of determining the relationship between the premenstrual tension state and neurosis, neurotic predisposition, personality type and general stability.

B. EXPERIMENTAL POPULATION.

The experimental population consists of a total of 145 patients comprising random samples of 61 normal women and 84 patients attending the Psychiatric Department of East Glamorgan Hospital and Psychosomatic and Allergy Clinics of St. David's Hospital, Cardiff. It was considered that such a group was likely to provide a wide variation in intensity of neurosis and emotional stability ranging from the normal stable person to the severely neurotic and maladjusted patient.

C. METHODOLOGY.

Data were collected, by interview, relating to menstrual history and symptomatology, family history, childhood neurosis, adjustment at school, work and marriage and personality assessed both in terms of general stability and clinical type. In the normal group the Maudsley Medical Questionnaire and Word Connection tests (Eysenck, 1947) were used as additional methods of detecting and assessing neurosis. Following assessment at clinical interview, patients were given a special chart for daily recording of a series of premenstrual symptoms and related items. Detailed instructions for guidance in the recording of data were given to each patient in order that the recording of symptoms might be reasonably standardized. The day-to-day records were made over a number of menstrual cycles, thus enabling a detailed assessment of premenstrual tension to be carried out.

The information was then entered on a special item sheet containing some 200 items for each patient. A number of features were rated according to severity on a 7-point scale, e.g., degree of premenstrual tension, existing neurosis, general adjustment, personality stability. Various other symptoms were graded on a three-point scale according to severity.

The information on the item sheets was finally transferred to Hollerith punched cards and analyses carried out by means of the Hollerith Counter Sorter.

D. FINDINGS.

Incidence of Premenstrual Tension.(1) *Total group.*

In the total group of 145 subjects, 56.5 per cent. had no significant premenstrual tension symptoms, 24.8 per cent. had premenstrual tension symptoms of moderate intensity, and 15.6 per cent. had severe premenstrual tension states.

(2) *The Incidence of Various Grades of Premenstrual Tension in the Normal, Psychiatric and Psychosomatic Groups is as follows :*

	Normal.	Psychiatric and psychosomatic patients.	Statistical significance of difference.
	(%)	(%)	(%)
No premenstrual tension . . .	78.7	38	**
Moderate premenstrual tension . .	16.4	30	*
Severe premenstrual tension . . .	5	32	**

The statistical significance of the differences of percentages was determined by the critical ratio. A critical ratio of 2 + is denoted by *one asterisk* and a critical ratio over 3 by *two asterisks*. This method of denoting statistical significance will also be employed in the remaining tables. Thus, if these groups can be regarded as random samples, there appears to be a higher incidence of premenstrual tension in psychiatric and psychosomatic patients than in normal women.

As there is no sharp dividing line between neurosis and normality, and as neurotic symptoms are often exaggerations of normal personality traits or attributes, it is desirable to attempt an assessment of the stability and degree of neurosis in the normal control group. This was carried out by clinical interview, and by means of the Maudsley Medical Questionnaire and Word Connection test. Data obtained on family history, childhood neurosis, personality type and stability indicated a low incidence of emotional instability, existing neurosis or evidence of neurotic predisposition. Similarly, testing with Maudsley Medical Questionnaire and Word Connection test revealed a low incidence of neurotic responses.

Comparison, within the normal group, of subjects with premenstrual tension with those free from premenstrual tension symptoms revealed no significant difference in incidence of personality instability or neurosis.

Thus premenstrual tension can exist in women with little or no evidence of instability in personality, maladjustment or of neurosis or predisposition to neurosis. Conversely, many women with severe neurosis do not suffer from premenstrual tension, e.g., in the group of 82 patients free from premenstrual tension symptoms 20 per cent. had a severe neurosis, 23 per cent. showed clear evidence of neurotic predisposition and 18 per cent. had very unstable personalities.

Thus neurosis or emotional instability in itself is not sufficient to account for the premenstrual tension syndrome.

(3) *Predisposition to Neurosis and the Premenstrual Tension Syndrome.*

Slater (1942) has considerably clarified the concept of the neurotic constitution. According to Slater's hypothesis, neurosis represents a special case of a generalized type of behaviour and signifies a failure of adaptation. The two primary reagents are the individual constitution and environmental set up of the moment. The former determines the form and severity of the neurosis, and the latter the time and to a lesser extent the severity of the symptoms.

The best indicators of the neurotic constitution are the following: clinically abnormal personality, neurosis in childhood, positive family history and poor work record. Data on these features are given in Table I for the total group subdivided as follows:

- (1) 82 subjects with no significant premenstrual tension (ratings of 2 and less).
- (2) 36 subjects with moderate premenstrual tension (ratings of 3 and 4).
- (3) 27 subjects with severe premenstrual tension (ratings of 5 and over).

It will be seen from Table I that on the evidence of a history of childhood neurosis, personality stability and clinical abnormality, the patients with severe premenstrual tension have the most marked neurotic constitution.

On the basis of the criteria laid down by Slater (1942) each subject was rated on a 7-point scale according to evidence of severity of neurotic constitution. Taking ratings of 2 and less as mild, 3 and 4 as moderate and 5, 6 and 7 as severe degrees of neurotic constitution and comparing the grades with various degrees of premenstrual

TABLE I.

Family history.	Degree of premenstrual tension.			Statistical significance of difference between group with severe and group with no premenstrual tension.
	Nil. (%)	Moderate. (%)	Severe. (%)	
Negative	75.6	69.4	74	
Neurosis mild	14.6	11.1	7.4	
Neurosis severe	7.3	13.9	14.8	*
Psychosis	2.4	5.6	0	
Epilepsy	1.2	0	0	
<i>Childhood neurosis.</i>				
Nil	68	58.3	52	
Mild	6.1	5.6	0	
Moderate and severe	20.7	27.8	40.7	*
<i>Personality.</i>				
Stable	72	41.5	7.4	**
Somewhat	19.6	41.5	52	**
Very unstable	3.7	8.3	29.6	**
<i>Meek, dependent, timorous.</i>				
Not	73	47.1	11.1	**
Somewhat	17.1	25	33.3	**
Very	7.3	19.4	52	**
<i>Anxious.</i>				
Not	63.4	22.2	3.7	**
Somewhat	13.4	22.2	14.8	**
Very	22	52.6	81.5	**
<i>Obsessional.</i>				
Not	79.4	52.6	33.3	**
Somewhat	15.8	19.4	33.3	**
Very	3.7	13.9	29.6	**
<i>Hysterical.</i>				
Not	88	88.7	55.5	**
Somewhat	4.9	5.6	29.6	**
Very	0	0	3.7	
<i>Hypochondriacal.</i>				
Nil	86.7	77.6	63	**
Moderate	7.3	16.6	25.9	**
Severe	1.2	2.8	11.1	**

tension, the relationship between severity of premenstrual tension and the neurotic constitution shows up clearly (Table II).

It will be seen that there is a positive correlation between rating of neurotic constitution and rating of premenstrual tension. Thus it seems that the greater the predisposition to neurotic breakdown the greater the intensity of premenstrual tension symptoms.

TABLE II.

Severity of premenstrual tension.	Degree of neurotic constitution.		
	<i>Nil</i> or mild. (%)	Moderate. (%)	Severe. (%)
<i>Nil</i>	76	17	7
Moderate	56	36	8
Severe	15**	48**	37**

(4) *Co-existing Neurosis and Severity of Premenstrual Tension.*

Table III gives the distribution of types of neurosis among the various grades of premenstrual tension.

TABLE III.

Degree of premenstrual tension.	Type of neurosis.			
	None. (%)	Anxiety state. (%)	Depressive state. (%)	Hysteria. (%)
<i>Nil</i>	81	15	0	4
Moderate	69	25	3	3
Severe	30	59	4	7

Thus the severe premenstrual tension group has a higher incidence of neuroses than the group with no premenstrual tension.

TABLE IV.

Degree of premenstrual tension.	Degree of neurosis.		
	<i>Nil</i> or mild.	Moderate.	Severe.
<i>Nil</i>	82	15	6.0
Moderate	97	3	0
Severe	22.2**	44.4**	33.3**

From Table IV it will be seen that there is a positive correlation between the severity of neurosis and the intensity of premenstrual tension symptoms. The more severe the neurosis the greater is the intensity of premenstrual tension symptoms. The differences between the severe premenstrual tension group and the group with no premenstrual tension are statistically significant.

It is interesting to note that the onset of premenstrual tension symptoms antedated the onset of neurosis in over 90 per cent. of cases.

(5) *General Stability and Adjustment in Relation to Severity of Premenstrual Tension.*

Each subject was assessed regarding her adjustment at school, work, or marriage. A composite rating of adjustment is based on these assessments and given in Table V.

TABLE V.

Degree of premenstrual tension.	Degree of maladjustment.		
	<i>Nil</i> or mild. (%)	Moderate. (%)	Severe. (%)
<i>Nil</i>	92	8	0
Moderate	80	14	6
Severe	41	48**	11**

It will be seen that patients with a severe degree of premenstrual tension have a significantly higher incidence of moderate and severe degrees of maladjustment than the group with no premenstrual tension.

(6) *The Age Factor.*

The results, so far, are quite definite, but it is desirable to ascertain whether the differences found could be attributed to other factors such as age, particularly as the age distribution of the three groups differs as shown below :

Degree of premenstrual tension.	Age-groups.			
	15-24. (%)	25-34. (%)	35-44. (%)	45+. (%)
<i>Nil</i>	48.8	28	9.8	13.4
<i>Moderate</i>	25.0	30.6	27.8	16.6
<i>Severe</i>	7.5	29.6	29.6	33.3

The group with no premenstrual tension symptoms is younger in age distribution than the moderate and severe premenstrual tension groups.

We have, therefore, to consider the possibilities that premenstrual tension is more severe in older age-groups or that the incidence or severity of neurosis is greater in older people.

It is therefore necessary to control the age factor, and to ascertain whether the positive correlation between degree of premenstrual tension and degree of neurotic constitution, personality instability, maladjustment and co-existing neurosis still obtains.

An analysis was accordingly carried out on the three grades of premenstrual tension accurately matched for age. Each group consisted of 24 women and the results are given in Table VI.

TABLE VI.

Degree of premenstrual tension.	Neurotic constitution.		
	Mild. (%)	Moderate. (%)	Severe. (%)
<i>Nil</i>	62.4	16.7	20.8
<i>Moderate</i>	45.8	12.5	41.7
<i>Severe</i>	16.7	37.5	45.8*
<i>Personality instability.</i>			
<i>Nil</i>	66.7	12.5	20.8
<i>Moderate</i>	45.8	12.5	41.7
<i>Severe</i>	20.8	25	54.2*
<i>Degree of maladjustment.</i>			
<i>Nil</i>	79.2	0	20.8
<i>Moderate</i>	75	8.4	16.7
<i>Severe</i>	41.7	12.5	45.8*
<i>Co-existing neurosis.</i>			
<i>Nil</i>	79.2	20.8	8.4
<i>Moderate</i>	58.4	8.4	33
<i>Severe</i>	20.8	37.5	41.7**

Thus the correlation between degree of premenstrual tension and neurotic constitution, instability, maladjustment and degree of co-existing neurosis still holds good and cannot be attributable to the age factor.

(7) *Symptomatology.*

The onset of premenstrual tension symptoms varies from 2-12 days before the period. Over two-thirds begin having symptoms 6-12 days before the menses. In the majority of patients the symptoms pass off soon after the onset of menstruation, but some 15 to 18 per cent. continue to have symptoms throughout the period.

The following is the incidence of various symptoms in our group: General tension and irritability 100 per cent., depression 80 per cent., anxiety 77 per cent., swelling of fingers or legs 74 per cent., painful swelling of breasts 66 per cent., insomnia 40 per cent., fatigue 66 per cent., headaches 66 per cent., palpitations 40 per cent., nausea or vomiting 33 per cent., pruritus 33 per cent., dizziness 25 per cent., marked thirst 20 per cent.

Some patients reported increased appetite, especially for sweet things, and others increased sex desire. In patients subject to such conditions an increased tendency to asthma, vasomotor rhinitis, angioneurotic oedema and migraine was noted.

(8) *Age of Onset of Premenstrual Tension.*

Degree of premenstrual tension	Age-groups.			
	15-24 yrs.	25-34 yrs.	35-44 yrs.	45+
Moderate	58.3	27.8	8.3	4.6
Severe	59.2	14.8	14.8	11.1

Nearly 60 per cent. of patients with premenstrual tension started during the age range 15-25 years and nearly 80 per cent. before the age of 35. In the majority of patients premenstrual tension occurred before marriage. Of the married women 50 per cent. had no children, but in some patients with children it was found that premenstrual tension had developed or had become worse after childbirth. A small proportion of patients develop premenstrual tension for the first time just before the onset of the menopause.

(9) *Menstrual Data.*

Menarchial age.—It will be of interest to compare the menarchial age of women who suffer from premenstrual tension with those who do not.

Age at menarche.	Degree of premenstrual tension.		
	Nil.	Moderate.	Severe.
9-10	1.2	0	0
11-12	34.5	15.7	3.7
13-14	43.8	41.6	40.7
15-16	14.6	27.7	29.6
17	1.2	5.6	7.6
	35.7%	15.7%	3.7%
	15.8%	33.3%	37.2%

It will be observed that patients with moderate and severe degrees of premenstrual tension have a higher incidence of persons with later menarchial ages than those with no premenstrual tension.

Average duration of menses.—It was found that cycles were very rarely constant both regarding length of menses and the duration of the cycle.

37 per cent. of patients with severe premenstrual tension had menses lasting on an average more than 7 days compared with 16 per cent. in the moderate premenstrual tension group and 18 per cent. in the group with no premenstrual tension.

E. DISCUSSION.

Our findings indicate that severe premenstrual tension symptoms can occur in normal women with little or no evidence of neuroses or neurotic predisposition. If the groups can be accepted as random samples it appears that premenstrual tension however, is more frequent among neurotic subjects. Furthermore, there is a positive correlation between the intensity of premenstrual tension symptoms and severity of neurosis, general instability and neurotic predisposition.

Thus while marked premenstrual tension syndrome can occur in the absence of neurosis or personality instability, when these conditions co-exist they are positively correlated.

The condition cannot be dismissed as being neurotic or primarily psychogenic. There are many severely neurotic women with no significant premenstrual tension. In the patients with severe premenstrual tension and also a neurosis, the onset of premenstrual tension antedated the onset of neurosis in all patients except one. Many patients with neuroses responded to psychiatric therapy without significant improvement in the premenstrual tension state, and it was possible to eliminate premenstrual tension symptoms by pharmacological methods to be described without significantly affecting the co-existing neurosis.

It is not considered that conscious anticipation of the menses was an important factor. As a rule women have already developed premenstrual symptoms without

realizing the relationship with phases of the menstrual cycle. Deutsche (1947) considered premenstrual tension to be due to an unconscious perception of the approaching menses. Even if unconscious perception is not self contradictory such statements are as difficult to accept as to refute.

In order to consider the premenstrual tension syndrome fully it is necessary to consider psychological aspects of the menstrual cycle along with biochemical, endocrine and physiological changes.

PSYCHOLOGICAL ASPECTS.

(a) *Social-cultural Influences.*

From ancient times menstruation has been a subject of taboos. Frazer in *The Golden Bough* describes a large number of prohibitions and restrictions placed on the menstruating women. Rosenzweig (1943) considers that many of the restrictions applied to-day in our society on the menstruating women, e.g., prohibition of bathing, is a survival of earlier superstitions. Even nowadays men often regard menstruating women as being disgusting or contagious or in other ways dangerous or harmful, and women themselves have special attitudes to menses relating to anxiety and superstition. Such social cultural influences, although important determinants of attitudes to menses, do not explain why some patients develop premenstrual tension and other equally sensitive, susceptible and unstable individuals remain free from the syndrome.

(b) *Personal Attitudes.*

Personal attitudes to the menses differ widely. This is shown by the variety of names given by different women to the menses.

A woman's attitude to her menses will be influenced by a large number of factors.

The way a girl is prepared for her first period may have an important influence on her future attitude to menstruation. Deutsche (1947) believes that the attitude of the girl to her mother is often the determining factor in the emotional response to her menses. Some will display hostility and aggression for not being adequately prepared for the first period, while others will make an excellent adjustment if their mothers show understanding and gentleness at the time.

The appearance of the first period was described as a severely emotionally upsetting experience in 25 per cent. of the severe premenstrual tension patients, compared with 8.3 per cent. in the moderate premenstrual tension group and 10 per cent. in the group with no premenstrual tension. It is difficult to know what significance to attach to this, as it is possible that patients with severe menstrual disturbances would tend to remember emotional upsets at the menarche more readily than patients free from such symptoms. It is interesting to note that 12 per cent. of the normal group stated that the menarche was an emotionally disturbing experience.

Menstruation is experienced as evidence of the difference between the sexes and as indicating her future function of pregnancy and childbirth. Thus a woman's attitude to the feminine role and also to child-bearing may influence her attitude to her periods.

(c) *Fluctuations in Emotions, Activity and Interests during the Menstrual Cycle.*

Jacobi (1877) propounded the menstrual wave theory, and described menstrual symptoms as a cyclical ebb and flow of somatic functions.

Havelock Ellis (1930) quotes the work of Ott (1890) and Engleman (1900), who reported cyclical changes with a maximum excitability about 3 days before the onset of the menses.

McCance *et al.* (1937), in a careful statistical study of day-to-day records in normal women, noted a tendency for depression to occur just before and during the early stages of the period but not an overwhelming incidence as suggested in the literature. There was a tendency for depression, elation, pain, fatigue and sexual feeling to be low in incidence around the 2nd to 23rd day. They describe the week before the periods in this normal group as a dull and unemotional period. This is the antithesis of the severe premenstrual tension state, and the findings of McCance and co-workers indicate the premenstrual tension state as not likely to be an exaggeration of normal changes at this time.

Altman *et al.* (1941), however, reports from a detailed study of 10 normal subjects that there was a tendency for an outburst of physical and mental energy before the onset of menstruation, coupled with high tension and irritability and preceded or accompanied by depression. During the ovulation phase there was a tendency for increased activity and elation free from tension.

Benedek and Rubenstein (1939) carried out a detailed psychoanalytic study of a small series of neurotic women in which the psychological findings were correlated with data on vaginal smears and basal body temperatures.

They found that oestrogen production was paralleled by active sexual energy which dominates behaviour. Progesterone production was found to be correlated with a passive direction of psychosexual energy, calmness and passive receptive tendencies.

These interesting findings of Benedek and Rubenstein would appear to be in agreement with the hypothesis that the premenstrual tension state is due to the action of unantagonized oestrogens, and accounts for the absence of a "quiet phase" before menstruation in patients with the premenstrual tension syndrome.

Biochemical Changes.

1. Salt and Water Metabolism.

A number of clinical reports have mentioned a tendency to water retention during the premenstrual phase. Thorn (1938) found retention of sodium and water premenstrually. Thomas (1933) described two patients with massive generalized oedema amounting to 12-18 lb. in the premenstrual period. Greenhill and Freed (1941) postulated that sodium and water retention, giving rise to an increase in extra-cellular fluid in various parts of the body, was the immediate cause of premenstrual tension symptoms.

Sodium retention according to Thorn (1938) is due to the action of ovarian steroids. Morton (1950) in a careful study of 29 patients with premenstrual tension found hydration to be a feature of the premenstrual phase. He found in two surgical castrates and menopausal women with no evidence of significant oestrogen activity that large doses of oestrogen produced a gain in weight and increased nervous tension.

2. Carbohydrate Metabolism.

Increased sugar tolerance was noted by Morton (1950) in nearly two-thirds of his premenstrual tension patients. The glucose-tolerance curves were low and plateau-shaped. This increased sugar tolerance tends to result in hypoglycaemia. The feelings of fatigue as well as increased appetite which occur in some patients during the premenstrual period is considered by Morton to be due to hypoglycaemia. Billing *et al.* (1947) also report a definite increased sugar tolerance immediately prior to the menses, with marked flattening of the sugar tolerance curve in patients with premenstrual tension.

3. Endocrine Changes.

The periodic changes occurring in the endometrium from menarche to the menopause consist of growth, secretion, shrinkage and shedding. The crucial event of the menstrual cycle is ovulation (Bishop, 1950); on it depends not only the release of the ovum but the formation of the corpus luteum and the secretion of progesterone. Before ovulation the endometrium is solely under the influence of oestrogen which stimulates growth and proliferation. After ovulation the combined effect of oestrogen and progesterone leads to changes which are a prelude to pregnancy. Normal menstruation is due to diminished secretion of both oestrogen and progesterone. Follicle-stimulating hormone (FSH) of the pituitary controls the development of the Graffian follicle in the early days of the cycle. The production of luteinizing hormone (LH) later increases and ovulation is probably due to the fall of FSH and when the rise of LH reaches a certain point. A third gonadotrophic hormone, luteotrophin, maintains corpus luteum for about two weeks and causes release from it of progesterone.

Frank (1931) thought that premenstrual tension was due to a high level of circulating oestrogen brought about by a high renal oestrogen threshold. Israel (1938) thought that premenstrual tension was due to the action of unantagonized

oestrogen, and that the primary fault was lack of progesterone secretion due to faulty luteinization.

Gillman (1942), however, found that progesterone in doses of 10–30 mgm. given for 8–12 days of the cycle produced symptoms of premenstrual tension.

Morton (1950) studied 29 patients with premenstrual tension by means of daily basal temperature, endometrial biopsy, vaginal smears and urinary hormone assays. His findings indicated a decreased or absent secretion of progesterone which permitted an uninhibited rise of oestrogen in the premenstrual phase in patients suffering from premenstrual tension. The theory of premenstrual tension being due to high levels of oestrogen in the premenstrual phase is also supported by Greenhill and Freed (1945).

Thus the general weight of evidence appears to be in favour of the hypothesis that premenstrual tension state is associated with low progesterone and high level of unantagonized oestrogens.

4. Cardiovascular Changes.

Brewer (1938) maintained that premenstrual tension was due to increased capillary permeability, but Reynolds *et al.* (1941) were not able to observe any cyclical changes in capillaries during the menstrual cycle.

5. Autonomic Nervous System Changes.

Symptoms of autonomic activity are characteristic of premenstrual tension. Evidence of both sympathetic and parasympathetic overactivity may be found, e.g., tachycardia and palpitations, as evidence of sympathetic overactivity and vomiting, urinary frequency, asthma and vasomotor rhinitis as signs of parasympathetic activity. Forda and Wolf (1944) found that oestrogens increase synthesis of acetylcholine whereas androgens, progesterone and adrenocortical hormone decrease its synthesis.

Acetylcholine is known to mediate transmission of impulses at parasympathetic nerve-endings and at all ganglia of autonomic nervous system. This effect may explain the autonomic lability of the premenstrual tension syndrome.

6. Comparison of Premenstrual Tension Syndrome with General Adaption Syndrome.

Selye (1950) postulates that, in addition to many specific defence mechanisms, there is an integrated syndrome of closely interrelated adaptive reactions to non-specific stress itself. This has been termed the general adaption syndrome which develops in three stages:

- (1) Alarm reaction (AR).
- (2) Stage of resistance (SR).
- (3) Stage of exhaustion (SE).

Most of the characteristic changes in the AR disappear in SR and reappear on SE. The AR has a phase of shock characterized by tissue catabolism, hypoglycaemia and other features shown in the table below, which gives comparison with changes in premenstrual tension scale.

Phase of shock of alarm reaction.	Premenstrual tension.
Oedema	+
Urine output diminished	+
Haemoconcentration	+
Hypothermia	+
Hypotension	+
Hypochloraemia	+
Hyperkalaemia	+
Transitory rise in blood sugar	
Later fall in blood sugar	+

Selye (1951) finds that oestrogens can produce typical G.A.S. manifestations in experimental animals. Oestrogens have water-retaining properties, whereas progesterone and testosterone have diuretic properties (Selye, 1951). There is thus a general similarity between the stage of shock of the G.A.S. and the premenstrual

tension state. Selye's work on the physiological and biochemical changes in the alarm reaction, particularly his finding that oestrogens produce such reactions, in contrast to progestogens and testosterone, is in keeping with our findings on the clinical features and results of treatment of the premenstrual tension state. The alarm reaction according to Selye can also be evoked by emotions, which may therefore also contribute to the above changes found in the premenstrual tension state.

RESULTS OF TREATMENT.

Observations carried out on the effect of various methods of treating the premenstrual tension syndrome provide us with important clues on its aetiology.

Rees (1952) describes results obtained by treating a group of women with severe premenstrual tension states by various methods.

It was found that the condition was not amenable to psychotherapy alone. Psychotherapy was useful in helping the patient to understand the nature of the condition, and helping to modify her attitude and reaction to it in order to reduce the degree of disability incurred.

Dehydration therapy by means of ammonium chloride administration with limitation of sodium intake successfully prevented the increase of weight, swelling of subcutaneous tissues and various symptoms attributable to hydration, or removed them if they had already developed. Dehydration therapy, however, did not always remove the symptoms of tension and irritability, and it was considered that hydration did not account for all the symptoms of the premenstrual tension syndrome.

Progesterone by injection and ethisterone by mouth were effective in preventing or relieving hydration and the various symptoms of premenstrual tension state. Testosterone was also found to be effective. It was pointed out that progesterone, ethisterone and testosterone were diuretic and antagonistic in action to oestrogens, and that this appeared to be a possible explanation for their therapeutic efficacy.

SYNTHESIS AND FORMULATION.

The premenstrual tension syndrome is a complex psychophysical state determined by a multiplicity of factors.

Starting peripherally we have the following changes associated with the premenstrual tension state :

(1) *Tissue changes.*

(a) General : Hydration giving rise to swelling of subcutaneous tissues of fingers, feet, legs and other parts of the body and hydration of various organs. This accounts for increase in weight, tight feelings in skin, heavy feelings in head, bloated feelings in abdomen and pruritus.

(b) Specific : Proliferation of epithelia of breast, vagina and endometrium.

(2) *Changes in blood composition.*—Tendency to haemoconcentration, hypoglycaemia, increased insulin secretion and increased sugar tolerance.

(3) *Cardiovascular changes.*—Cardiovascular lability and according to some authors increased capillary permeability.

(4) *Hormonal.*—Probably imbalance of oestrogen and progesterone due to deficient or absent progesterone secretion permitting action of unantagonized oestrogens. Changes in pituitary-adrenocortical functions.

(5) *Nervous system changes* including generalized increased excitability and autonomic disequilibrium. The autonomic disequilibrium may be partly attributable to evocation of homeostatic mechanisms by the above changes, and may also be due to changes in acetylcholine production attributable to oestrogens.

These bodily changes are responsible for the majority of the symptoms and signs of the syndrome. The patient may react to these changes in the internal environment in different ways and her reaction will be influenced by—

(1) Constitutional factors, e.g.,

(a) Stability of the autonomic nervous system and homeostatic mechanisms.

(b) Personality type.

(2) Degree of general stability, i.e., her ability to cope and adjust to changes in the internal environment and stresses in the external environment. This stability will be reflected in—

- (a) General adjustment during life, to family, school, work and marriage.
- (b) Personality reactions and social interaction.
- (c) Incidence of neurotic and psychosomatic disorders.

There are thus two main components of the premenstrual tension syndrome.

- (1) The characteristic bodily changes.
- (2) The reaction of the person to such changes.

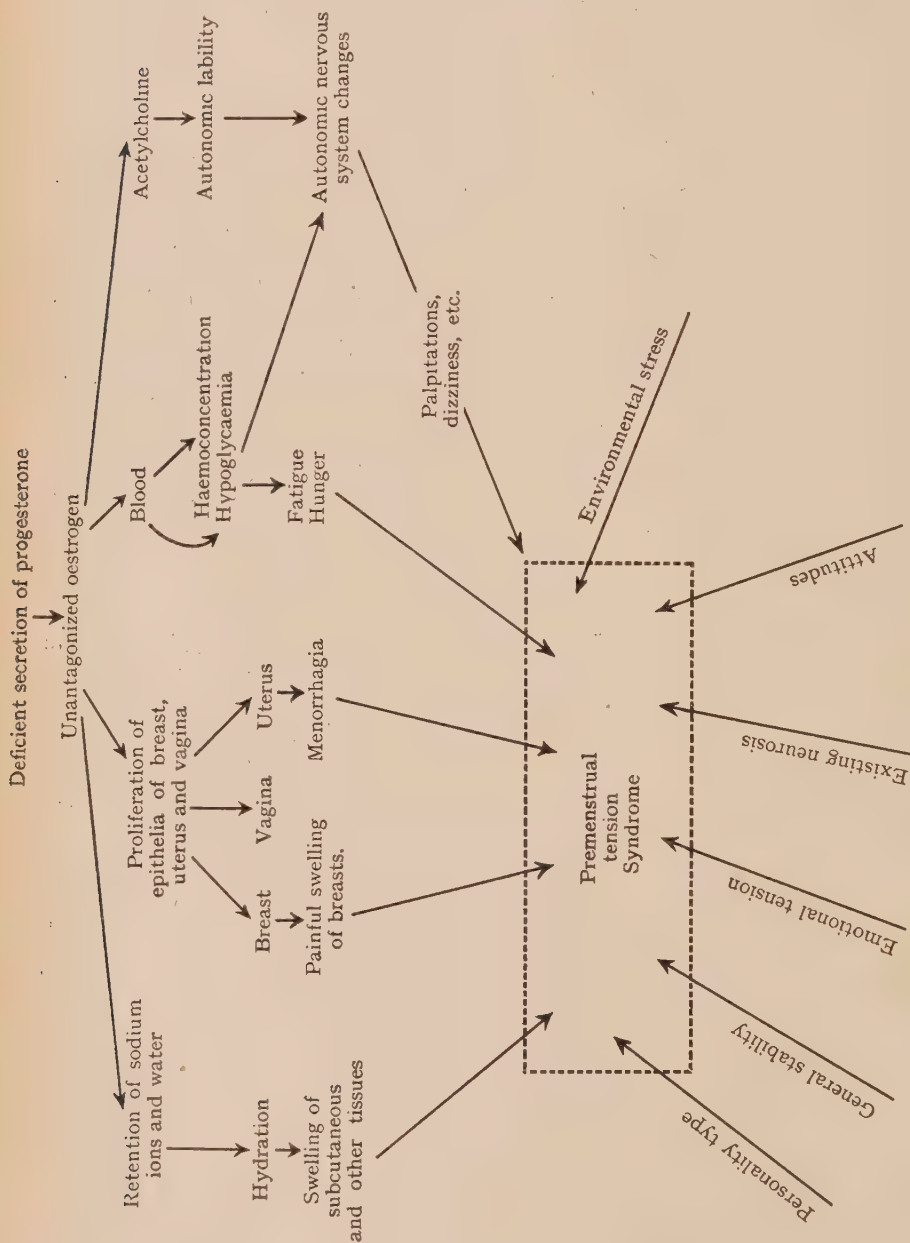


FIG. 1.—Schematic presentation of a working hypothesis of the premenstrual tension syndrome.

Our observations suggest bodily changes to be the primary factor in the syndrome.

The intensity of bodily changes will vary according to the degree of hormonal imbalance. Thus if the hypothesis of progesterone lack is verified, there could be a possible variation from a slight decrease of progesterone secretion to a complete absence. Progesterone lack would be more marked in some women than others and the resulting bodily changes would tend to be greater, the degree being also determined by the efficiency of the body's homeostatic mechanisms. Thus if the hormonal and other bodily changes described are marked it is possible to get premenstrual tension symptoms in women who are otherwise quite stable.

In unstable or neurotic women the intensity of symptoms and the degree of disability may be influenced in psychogenic factors as well as the above-mentioned physiogenic processes. Co-existent emotional tension, certain attitudes, environmental stress may also serve to accentuate premenstrual tension symptoms. A schematic representation of the syndrome is given in Fig. 1.

Treatment can be applied at various aetiological levels. Psychotherapy in the form of explanation and re-education can help, and dehydration therapy or treatment by means of progestogens or androgens can relieve the various bodily symptoms and signs of the premenstrual tension syndrome.

The syndrome should always be regarded and treated as a manifestation of the patient's total personality functioning as a psychosomatic unity.

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GARGOYLISM (HURLER'S DISEASE): A NEUROPATHOLOGICAL REPORT.

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HURLER'S disease is characterized by chondro-dystrophic skeletal changes, corneal opacities, hepatosplenomegaly and mental defect. The skeletal changes are such that the patient presents a large head, grotesque facies, deformed limbs and kyphosis.

Gertrud Hurler (1919) recognized the condition as a clinical entity and described two cases. Henderson (1940) drew attention to the fact that in 1900 John Thompson was first to associate the bizarre combination of clinical signs in one syndrome, but no records were published by him. Berkham (1907) contributed the clinical records of one case, and ten years later Hunter (1917) demonstrated two brothers who are now recognized to have been atypical examples of the disease. Putnam and Pelkam (1925), Helmholtz and Harrington (1931) and Ellis, Sheldon and Capon (1936) made notable contributions. The paper by Ellis and his colleagues reviewed the ten cases published up to 1936 and described with a detailed clinical analysis seven other cases which had come under their care.

Pathological studies were initiated by Tuthill (1934) with a description of one of Hurler's cases. This case was complicated by co-existing tuberculous meningitis. Three years later in 1937 Ashby, Stewart and Watkin published a detailed pathological study of one fully investigated case previously presented to the Royal Society of Medicine by Jewesbury and Spence (1921) as a case of acrocephaly with other skeletal deformities.

The neuropathological observations in this case were that ballooned nerve-cells infiltrated with lipid were found throughout the central nervous system, and that these cellular abnormalities were more marked in some situations than in others. In the cerebral cortex deeper lying pyramidal cells were more involved than those near the surface. Profoundly affected nerve-cells were particularly numerous in the optic thalamus, the mid-brain, the dentate nucleus of the cerebellum and the inferior olives of the medulla.

De Lange and others (1936), Kressler and Aegerter (1938) and Kny (1942) made only short reference to their neuropathological findings, but Green (1948) presented the second detailed neurohistological account in the literature of an uncomplicated, fully developed case of Hurler's disease. His case showed a slight disturbance of the characteristic cortical cyto-architectural pattern, a noticeable loss of nerve-cells and an involvement of all cortical neurones by the characteristic pathological process. He mentioned perivascular areas of tissue disintegration in the white matter corresponding to those found by Tuthill. There were compound granular corpuscles in the subcortical white matter. The striatum and pallidum showed severe cell changes, but the thalamus only slight damage. Very little change was detected in the Purkinjé cells of the cerebellum, but the nerve cells of the substantia nigra and the third and twelfth cranial nerve nuclei were in an advanced state of degeneration. The olivary nuclei and the nuclei pontis were well preserved. Although there was moderate gliosis in the cerebral cortex, glial proliferation was inconspicuous in the mid-brain, pons and medulla. The anterior horn-cells of the spinal cord displayed the pathological process most intensely.

Only three* full neuropathological studies of undisputed typical cases are thus available in the literature and of these the two uncomplicated cases fully reported by Green, and by Ashby, Stewart and Watkin show some histological differences. The main characteristic of nerve cell ballooning by infiltration with lipid, however, is well established. A feature which has not received sufficient attention apart from brief mention by Tuthill, is the perivascular lacunation confined to the white matter. This finding represents a conspicuous feature of the morbid anatomy of

* A third case giving a detailed neurohistological account has recently been published by Henderson *et al.* *Arch. Dis. Child.*, **27**, 230, 1952.

the brain. It is proposed, therefore, to supplement the sparse histological literature on Hurler's disease and to describe and illustrate the lacunar appearance of the white matter.

Case 1 : M. L.—, aged 9, male.

This was a placid, inarticulate idiot of 9. The first available clinical examination showed that the physical signs characteristic of the disease were present at the age of three. The skull was large and frontally bossed. The lower jaw was massive, the teeth spaced out and the nasal bridge depressed. The corneae were larger than usual and showed generalized opacity. Kyphosis was present in the lower thoracic spine, the sternum was sunken and there was a costo-chondral groove. The liver extended to two inches below the rib margins and the spleen was easily palpable. The patient was not deaf.

Death was due to bronchopneumonia.

Pathological Examination.

The brain was not altered in shape. The pia mater presented a ground-glass appearance, and here and there in the parietal region there were small discs of subarachnoid haemorrhage. The basilar artery was exceptionally slender. The gyral pattern was normal, but the sulci were somewhat widened. The whole brain imparted a certain resistance to the feel, resembling poor quality indiarubber, a consistency which was especially appreciable during section. The cut surfaces demonstrated a remarkable condition of the white matter. Arranged radially and in all areas were innumerable oval cystic spaces of varying sizes lying with their long axes in the direction of radiating white fibres. No such spaces were evident in the grey matter.

Nissl preparations showed a mild disturbance of architectural pattern and a slight reduction in cell numbers. Layers III and V were most depleted of cells, whereas the remaining layers were relatively well preserved. The neurones in all cortical areas showed striking changes. The bodies were markedly swollen ; some were only slightly distended, whereas others were extremely dilated and very many had the "ballooned" or "pear-shaped" appearance so characteristically found in amaurotic family idiocy. The Nissl substance had completely disappeared in many and the poorly outlined nucleus could be seen pressed against the cell wall. Where some of the tigroid bodies still remained these were crowded around the periphery of the displaced nucleus, which was very often to be found at the base of the apical dendrite. The nuclei were pyknotic, sometimes staining heavily and sometimes taking little if any stain. The nucleolus appeared in nearly every case deeply stained.

Silver impregnation according to Bielschowsky's method demonstrated a disturbance of the normal fibrillar arrangement. Intracellular neurofibrils were thrust to one or other side against the cell wall, leaving the whole cell occupied apparently by only small shreds of silver-stained material.

All glial cells actively participated in the cortical histological changes. Astrocytes showed proliferative and degenerative changes. Compound granular corpuscles were evident around the small blood-vessels. Oligodendroglial nuclei were pyknotic, but showed no halo formation. Holzer preparations disclosed a severe marginal fibrous gliosis penetrating to the third cortical layer and a milder gliosis extending into the subjacent layers. Proliferated fibrous astrocytes were also apparent in sections stained by the Hortega silver carbonate method. Penfield's stain confirmed diffuse microglial proliferation and an increase in the numbers of oligodendroglia.

The neuronal and perivascular fat was demonstrable by a number of lipid staining methods. Herxheimer's Scarlet Red, Sudan Black, Kay and Whitehead's Sudan IV, Jackson's Acetic-carbol-Sudan III and Telford Govan's modification of Sudan III staining in aqueous media were employed.

Herxheimer's method revealed the presence of crowded globules of fat in the ballooned neurone. In the severely affected cell the lipid seemed to displace all other intracellular elements to one side, and in other cases where the deposits were smaller they appeared to originate at a point directly opposite the main axonal base. Sudan III stained the lipid inclusions deep orange and Sudan Black stained them black.

The strikingly prominent feature of the white matter was the oval radiating "cysts." These were not devoid of structure, and in Perdrau stained preparations a fine reticulum was easily visible. In van Gieson stained sections the strands appeared to be fibroblastic and of adventitial origin arising from the vessel invariably situated within the space. Fibroblast nuclei were visible, and numerous large fat engorged compound granular corpuscles could be seen. In the subcortical white matter where the smaller oval spaces were generally situated the cysts were often crowded with these cells. They were less obtrusive in the large cysts in the deeper reaches of the white matter. The cyst wall showed evidence of demyelination, and Holzer preparations demonstrated a dense ring of fibrous gliosis along the cyst margin. Herxheimer's Scarlet Red stained the fat contained in the gitter cells within the spaces a brilliant red, whereas the intraneuronal inclusions stained orange.

The remaining white matter showed generalized moderate fibrous gliosis throughout, and severe gliosis in some regions.



FIG. 1.—(Case 1). *Parietal cortex*. $\times 240$. Nissl. The nerve-cells show the typical vacuolation of the cytoplasm and ballooning of the cells seen in lipid infiltration.



FIG. 2.—(Case 1.) *Occipital lobe*. $\times 15$. Heidenhain. Numerous oval lacunae are found in the white matter and are generally radially arranged.

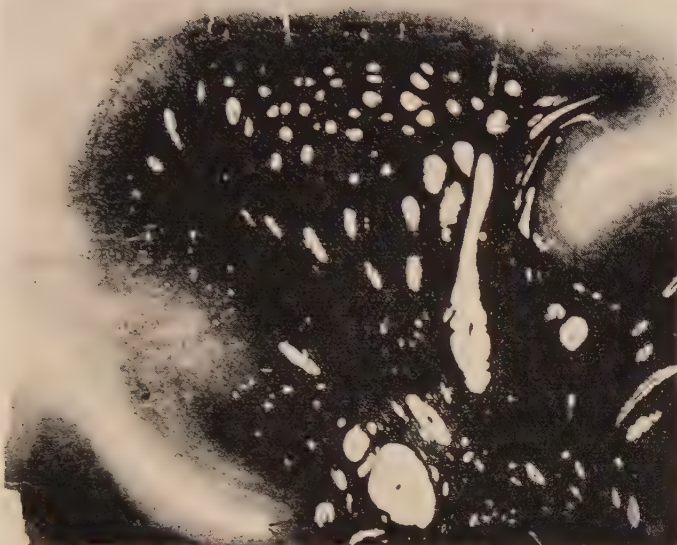


FIG. 3.—(Case 1.) *Occipital lobe.* $\times 6$. Heidenhain. The lacunae are oval and often elongated. There is almost invariably a vessel within each space.

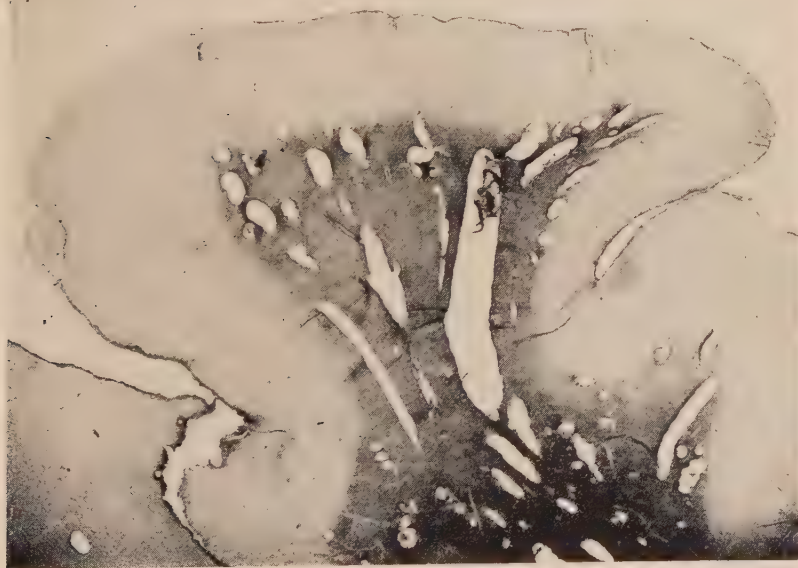


FIG. 4.—(Case 1.) *Occipital lobe.* $\times 6$. Holzer. The white matter shows generalized severe fibrous gliosis. The lacunae are bounded by a thin dense band of gliosis.

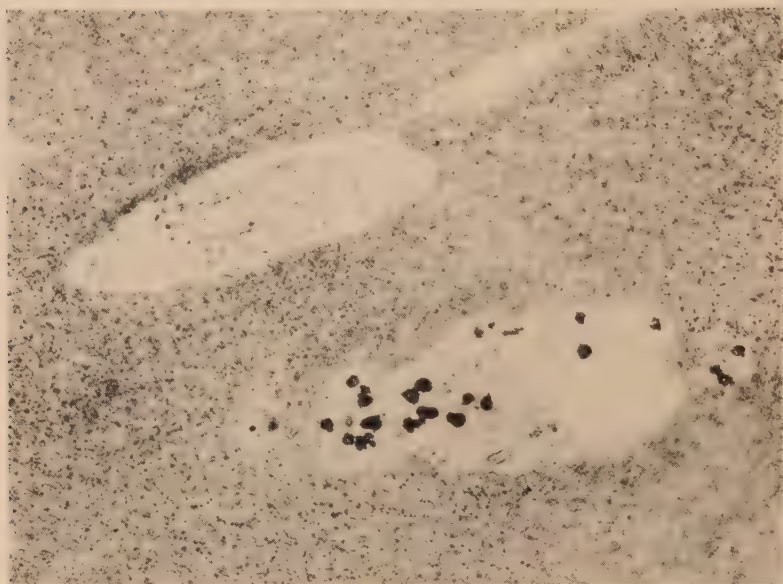


FIG. 5.—(Case 1.) *The lacunae.* $\times 120$. Herxheimer. Compound granular corpuscles within the lacunae.

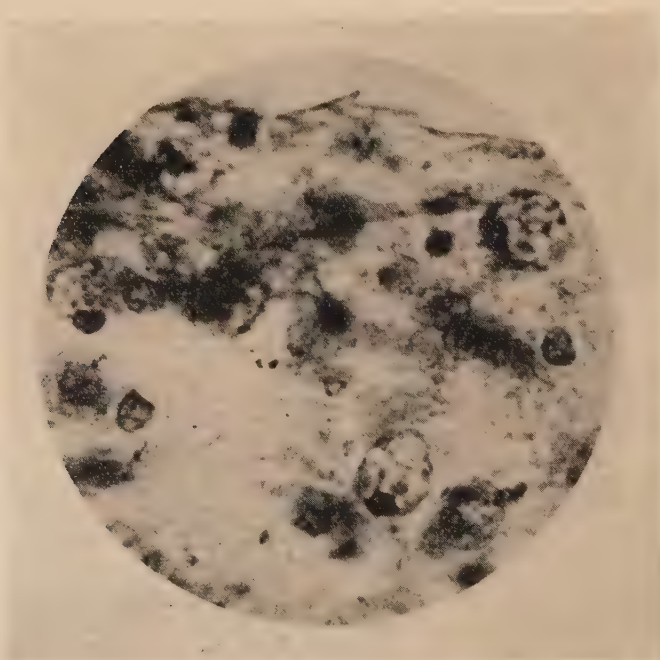


FIG. 6.—(Case 1.) *A lacunar wall.* $\times 810$. Herxheimer. Compound granular corpuscles in the lacunar wall.

The typical cell changes in the caudate nucleus were as common as the cell changes of the cortex. The large cells were more severely affected than the smaller ones and this incidence upon the large cell was also seen in the putamen. There was a concomitant increase in all glial elements. The pallidum cells showed involvement, and many of them had almost totally disappeared, leaving only a faint outline. The neurones of the thalamus were nearly all involved, but not to the same degree as the large cells of the corpus striatum. Notwithstanding the apparent widespread involvement there were groups of normal cells.

Herxheimer's fat method demonstrated a great deal of lipid in the cells of the basal ganglia, but the smaller neurones appear to contain only a small volume of intracellular fat. Hortege and Holzer preparations disclosed a considerable gliosis.

Brain stem ganglion cells, particularly in the cranial nerve nuclei, were as involved as the neurones of the cortex, but the cells of the pontine nuclei appeared not very heavily damaged. The cells of the inferior olivary nuclei were in a good state of preservation. The hypoglossal nucleus was the site of most intense damage. There was extensive gliosis in the brain stem, but most marked was the subependymal fibrous gliosis in the floor of the fourth ventricle. Heavily gliosed also was the dorsal nucleus of the vagus nerve.

The molecular layer of the cerebellum was normal and the granular layer showed no atrophy. The Purkinje cells stained very lightly and were slightly reduced in numbers. Many of the remaining cells were moderately affected. The dentate nucleus did not show much ballooning of its cells. Numerous small perivascular cysts were visible in the cerebellar white matter and each was delimited by a thin band of gliosis. The cerebellar white matter, however, was not so densely gliosed as the cerebral white matter.

In the spinal cord all neurones presented some degree of ballooning and a few reached very large proportions. The myeloarchitecture of the cord was undisturbed and there was comparatively little gliosis.

Case 2: W. W—, aged 5, male.

This was a placid, inaccessible, inarticulate low-grade imbecile.

The first full examination at the age of four showed a large skull, massive mandible, sunken nasal bridge, opaque corneas, spaced-out teeth, kyphosis of the lower thoracic spine and a mongoloid "trident" hand. The protuberant abdomen showed an umbilical hernia. The liver and spleen were both enlarged.

Death was due to bronchopneumonia.

Pathological Examination.

The cerebral and cerebellar hemispheres were symmetrical. The meninges showed increased vascularity and small areas of thickening and opacity of the pia arachnoid. The membranes stripped easily, revealing a normal convolutional pattern without atrophy. The vessels were normal.

Nissl preparations showed considerable cortical architectural disturbance in some areas and very slight alteration in others. The distribution of light and heavy damage did not follow any regional plan. In the most affected foci there was a disorientation of all layers with considerable numerical reduction in nerve cells. In the least affected areas the architecture was normal but abnormal individual cells were demonstrable.

These abnormal neurones showed ballooning, disappearance of Nissl substance, displacement of the nucleus to one side, and distension of the cell body with fatty inclusions. Bielschowsky preparations showed neurofibrillar displacement in the most affected cells. The occipital cortex showed the greatest incidence of damage. In this region there were certain areas where no normal cell was seen, and some nerve cells showed very severe swelling and gross distortion of their contours. The parietal and temporal lobes were affected next in order of severity. The Ammon's horn showed involvement of the neurones of the endfolium, but there appeared to be no reduction in cell numbers. The dentate fascia was not affected.

There was a great proliferation of glial cells in all areas, particularly in and around foci of maximal cell loss. Astrocytes showed both proliferative and degenerative forms. There was a marked increase of microglia. Oligodendroglial nuclei showed pyknosis. Holzer sections demonstrated a narrow band of dense marginal gliosis not extending further than the molecular layer except in areas where the cell loss was great. Microglial cell proliferation was evident, particularly in Penfield preparations.

Herxheimer's scarlet red stained the intracellular fat a deep orange. Sudan black stained the inclusions black and Sudan III by various techniques a pale orange.

The cerebral white matter in all sections demonstrated innumerable oval spaces arranged with their long axes radially placed. Microscopic examination showed that each of these cysts contained a vessel situated centrally and running along the greatest diameter, and that each space, although apparently empty macroscopically, was actually made up of a fine reticular network enmeshing many gutter cells. The reticulum itself showed fibroblastic nuclei. Each cystic space was bounded by a moderately dense area of fibrous gliosis, and within this area and for a short distance around there was demyelination. The corpus callosum contained a large elongated cyst about a centimetre in length. The reticu-

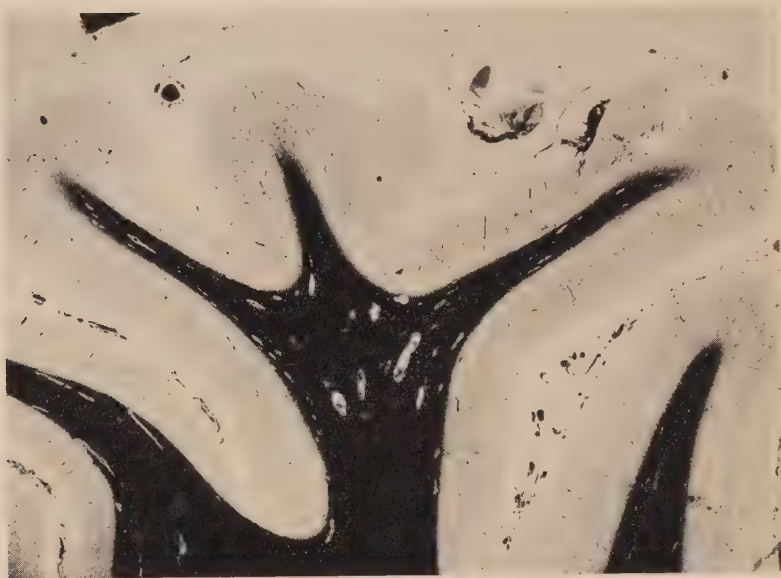


FIG. 7.—(Case 2.) *Occipital lobe.* $\times 5.5$. Heidenhain. Numerous radially arranged lacunae are seen.

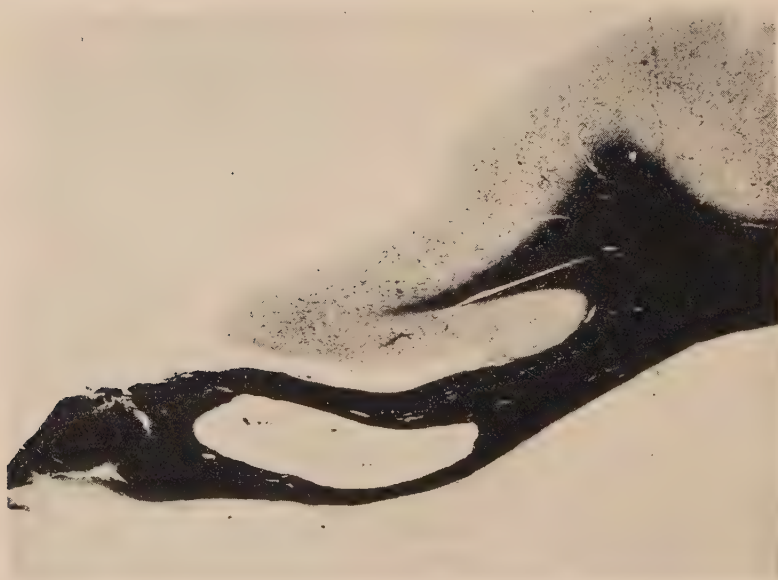


FIG. 8.—(Case 2.) *Corpus callosum.* $\times 5.5$. Heidenhain. A large single lacuna situated centrally in the corpus callosum.

lation within this space was coarse, and the individual strands were thick, showing fewer nuclei, but the interstices of the formation contained fat-laden gitter cells. This space, like the others, was bounded by dense gliosis.

The striatum was severely affected. The large cells were maximally involved, and a major proportion of the small cells was also damaged. The large cells of the globus pallidus had almost all disappeared; only a few ghost cells remained. The nerve-cells of the thalamus and of the hypothalamic nuclei were involved, but nowhere in these regions was the severe change common in the cortex to be seen.

All glial elements showed considerable proliferation spread throughout the whole extent of the basal ganglia. Gliosis was most dense in the subependymal regions.

The nuclei of the cranial nerves, particularly the hypoglossal, were most extensively damaged, and resembled the most damaged areas found in the cerebral cortex. The nigral

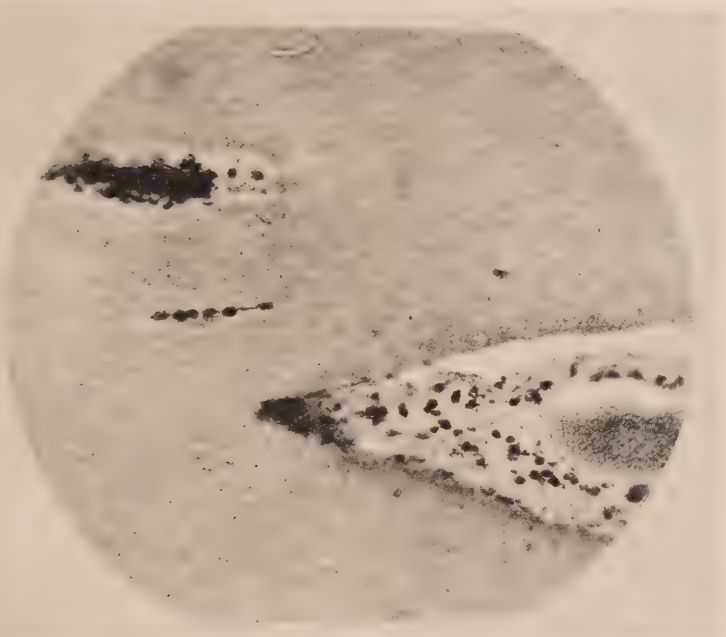


FIG. 9.—(Case 2.) *Lacunae*. $\times 100$. Herxheimer. The lacunae contain numerous fat-laden scavenger cells and a reticulum surrounding a central vessel.

cells showed changes similar to those in the cranial nuclei and there was considerable extra-cellular pigment. The pontine nuclei, however, showed little pathological change, and the inferior olives demonstrated no lesion.

There was moderate glial proliferation in the brain stem. Heavy gliosis was present in the subependymal area in the floor of the fourth ventricle.

The molecular and granular layers of the cerebellum were intact, but the usually lipophobic Purkinje cells were affected. The degree of damage of these cells did not vary greatly and no examples of severe distortion were evident. The cells of the dentate nucleus were moderately affected. The cerebellar white matter showed numerous small cystic spaces, as did the cerebral white matter. Specially stained sections disclosed a reticulum, enmeshed compound granular corpuscles, and a band of surrounding fibrous gliosis. There was demyelination for a small area around each cyst.

In the anterior horn of the spinal cord were typical damaged cells. Many of these cells were in the process of disintegration. The spinal cord was only mildly affected by gliosis, and there was no evidence of tract demyelination. In Herxheimer stained sections the lipid inclusions stained deep orange. Other fat stains were employed, but no atypical staining reactions were evident.

Special examination of material taken from both cases by the use of various lipid solvents did not give any clear evidence as to the nature of the lipid material.

DISCUSSION.

Hurler's disease falls into that now large category of lipid disturbances which includes Tay-Sachs' disease, Nieman-Pick's disease, Gaucher's disease and Hand-Schuller-Christian disease. Hurler herself emphasized only the skeletal manifestations of the syndrome when she called her first cases dysostosis multiplex, and Washington (1939) introduced the term "lipochondrodystrophy" in an attempt to include under one title all the pathological findings. The term "gargoylism" also stresses the unfortunate facies and skeletal changes of these patients.

The neurohistological similarities and differences shown by the cases of Tuthill, of Ashby, Stewart and Watkin, and of Green, and the two here presented warrant some analysis. The individual nerve-cells show identical changes in all five cases, and there is a remarkable similarity in the distribution of the most severe lesions. The cortex in all except Tuthill's case shows pronounced involvement, but on the whole no one layer or one type of cell suffers more damage than others. The large cells of the striatum are severely affected in four out of five cases. The thalamus is severely damaged only in Ashby, Stewart and Watkin's case, and the pallidum is degenerated markedly only in the second case presented in this communication. The hypoglossal suffers maximally among the cranial nerve nuclei. The substantia nigra is moderately severely involved, whereas the pontine nuclei are remarkably well preserved.

The cerebral and cerebellar white matter are described in Tuthill's case as having widely distended spaces surrounding the vessels. She believed these to be the end result of adventitial hypertrophy. The two cases presented in this contribution show this change in a very striking way. The perivascular lacunation was entirely confined to the white matter, no "cyst" being detectable in the cortex. The smallest vessels in the white matter, however, were often free from perivascular distension; the larger vessels invariably showed the spaces. It is possible that these spaces may be due to the distensile effect of an undue overcrowding of lipid substance around the vessels in the process of scavenging. The presence of a fine reticulum within the spaces and the failure to demonstrate the cysts around the smaller vessels where gutter cells were occasionally to be seen suggests that mechanical distension cannot wholly account for the finding. The dense mural fibrous gliosis and the circumjacent loss of myelin can be explained by the prolonged course of this disease. These two observations were conspicuous in the larger cysts, which showed little crowding with gutter cells, and were therefore presumably older. The loss of myelin is likely to be a direct consequence of the cyst formation and local nutritional failure.

Solubility tests by immersion of formalin fixed frozen sections in various lipid solvents followed by staining with lipophilic dyes seem not likely to add any substantial information to the study of this disease. Diagnosis of the precise chemical nature of the deposits from their staining properties with Sudan III has, as yet, no sure foundation. The nature of the lipid can only be elucidated by adequate biochemical work. Lindsay and his colleagues (1948) have suggested that a macromolecular substance allied to glycogen is involved and Smith and co-workers (1952) have produced evidence to show that the disease does not chiefly involve lipids. In a recent contribution Brante (1951) states that "Gargoylism should perhaps be conceived as a general disturbance in the metabolism of either the aminohexoses, the polysaccharides or the lipopolysaccharides." He also states that the subject of a subsequent paper will be a case showing a great increase of a polysaccharide-sulphuric acid ester in many tissues including the liver.

SUMMARY.

The neuropathology of two typical cases of Hurler's disease is presented. The ubiquitous alteration of nerve-cells by ballooning due to infiltration and distension by a lipid is described confirming the main finding in the previous reports on this subject.

The special feature described and illustrated in this communication is a widespread perivascular lacunation and vascular adventitial hypertrophy found throughout the white matter.

I am indebted to Professor A. Meyer and to Dr. L. T. Hilliard of the Fountain Hospital for making available the material presented in this paper. I also wish to thank Professor A. Meyer for permission to use photographs from the neuropathological collection at this Institute, and Mrs. Elisabeth Beck for the photography.

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AN EXPERIMENTAL INQUIRY INTO SOME ASPECTS OF THE MOTOR BEHAVIOUR AND PERSONALITY OF TIQUEURS.

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I. INTRODUCTION.

Tics are involuntary, repetitive or stereotyped movements which apparently lack purpose and which, with adults, tend to be permanent or long-term abnormal aspects of the individual's motor behaviour. The question arises whether certain basic psycho-motor and personality traits characterize persons who develop tics. No previous experimental work on this problem has been reported. In the present research, therefore, a preliminary attempt was made to describe precisely, by the use of psychological tests, certain aspects of the motor behaviour and some of the personality characteristics of tic patients and to compare the results with a similar examination carried out on matched, but non-tic, control patients.

II. SUBJECTS.

Nine tiqueurs and 9 controls were examined, this being all the adult tiqueurs that entered this hospital during the year in which this study was carried out. The movement disorders from which the tic group suffered included facial tics, widespread involuntary movements, especially of the upper limbs, and Gilles de la Tourettes syndrome. Some of the tics were apparently of organic origin, e.g., those following chorea; in others no organic basis could be discovered. The clinical condition of the patients in which these movement disorders occurred included schizophrenia, anxiety state, Sydenham's chorea, obsessive compulsive neurosis. Each of the tic patients was matched with a patient who could be used as a control. Sex, age, intelligence and clinical status were considered to be essential matching variables. With clinical matching, however, it is very difficult to match exactly, and so attention was paid particularly to matching for severity of illness. That this was achieved is supported by the scores of the two groups on an objective test of Eysenck's factor of "neuroticism" or emotional instability. On this test the Word Connection List (Crown, 1952), which is a controlled association test, the distribution of scores of the tiqueurs (11.8 ± 4.2) and the controls (11.4 ± 3.0) did not differ significantly. The matching for age and intelligence was also reasonably successful. The age distribution of the tiqueurs was 31.2 ± 5.2 , for the controls 33.7 ± 5.0 . The Progressive Matrices Test (Raven) was used whenever possible to match for intelligence using an I.Q. conversion table computed in this department. On four cases this was not possible, and the results on other tests, whose mean I.Q. is 100 and whose S.D. is approximately 16 points, were used. The mean I.Q. of the tiqueurs was 105.3 ± 7.0 ; of the controls 108.4 ± 6.2 . Statistical tests showed that for neither age nor intelligence did the groups differ significantly.

III. TESTS AND RESULTS.

The tests used may be considered in three categories: tests of skilled movements, tests of "expressive" movement, and a miscellaneous group of movement and personality tests. By "expressive" movements are meant individual peculiarities in the manner of performing adaptive acts (Allport, 1937). Short descriptions of all tests and of methods of administration and scoring will be given in this paper. Details of these, or similar, procedures may be obtained from the references quoted or directly from me.

The statistical analysis of each test consisted simply in computing the probability that the two samples came from the same population, taking into account the fact that the two groups were matched. This is allowed for in each of the significance tests by comparing the score of each person in the tic group with the score of his

matched control and making up a difference (D) column. The hypothesis to be tested is that the mean of the D-column is significantly different from zero. It is usual to do this using the *t*-test. In the present research Lord's (1947) modified *t*-test was used,* in which the test of significance is based on the use of the sample range rather than on the sample standard deviation. Using the D-column just referred to, the formula used is as follows :

$$\frac{\Sigma D}{R \times N},$$

Where

ΣD = sum of differences.

R = Range (highest—lowest D score).

N = Number of differences.

The ensuing number is then checked for significance using the Table 9 given by Lord. This significance test is slightly less efficient than the more usual *t*-test. It is, however, considerably easier to compute and, where the number of tests in an investigation is large, and the number of persons tested is small, is a useful significance test.

A. Tests of Skilled Movement.

(1) *Triple Tester* (Eysenck, 1947).

This is a type of pursuit-meter in which a "vehicle," in the form of a bronze ball, is steered along a line of holes in a brass drum which is rotating towards the S. The aim is to hit as many holes as possible. The apparatus is designed so that the response of the vehicle to the steering wheel is delayed and the S has, therefore, to anticipate the necessary moves. After a 30-sec. practice period the S does the task 4 times and the score is the average number of hits over the 4 trials :

$$N = 6 \quad M_T = 96.0 \quad M_C = 71.5 \quad s = 28.0 \quad P = 0.10,$$

where

N = Number of pairs.†

M_T = Mean of tiqueurs.

M_C = Mean of controls.

s = an estimate of the standard deviation of the D-column. Both this estimate and the tests of significance are based on the sample range instead of the sample standard deviation (cf. Lord, 1947).

P = Level of significance.

(2) *Mirror Drawing* (Eysenck, 1952).

The S is shown the apparatus, and it is demonstrated that when the apparatus is in position in front of him and his hand is in position on the base he cannot see his hand directly, but only in the mirror. A star shape is shown to the S in position on the base of the apparatus. His pencil is placed on the starting-point and he is told to trace round the star between the lines as quickly as possible. Six trials. Two scores : average time, 5 trials (first trial excluded) ; number of relapses :

$$\begin{array}{llllll} \text{Time} & . & N = 7 & M_T = 43.3 & M_C = 73.7 & s = 27.4 & P = 0.05. \\ \text{Relapses} & . & N = 7 & M_T = 0.9 & M_C = 0.4 & s = 1.1 & P = \text{Not significant (N.S.).} \end{array}$$

(3) *Dotting* (Culpin, 1931).

The apparatus, based on the McDougall-Schuster dotting apparatus, consists of an oblong box at the top of which is a small aperture beneath which passes a paper tape upon which small circles are irregularly spaced. The size of the aperture and the speed of the tape can be regulated. In the present experiment the size of the aperture was kept constant. With the speed at its slowest the task was explained to the S ; he was told that he was to try to tap as many dots as he could, and he

* I am indebted to Mr. A. S. C. Ehrenberg of this Institute for bringing the method to my attention.

† For practical reasons it was not always possible to test or to score all the subjects on every test.

was given a $\frac{1}{2}$ -min. practice period. Then he was given five $\frac{1}{2}$ -min. trials at increasing speeds and scored for the average number of hits over 5 trials :

$$N = 3 \quad M_T = 35.0 \quad M_C = 15.7 \quad s = 3.5 \quad P = 0.01.$$

(4) *R/V Manual Dexterity.*

This dexterity test of the National Institute of Industrial Psychology, consists of putting ball-bearings into holes, on the first trial with tweezers, the second trial with a scoop, and lastly between finger and thumb. Score is the total of the three attempts :

$$N = 2 \quad M_T = 50.0 \quad M_C = 43.0 \quad s = 19.5 \quad P = N.S.$$

B. *Tests of Expressive Movement* (Eysenck, 1952).

(5) *Three Circles.*

The S was handed a clean piece of paper and asked to draw three circles. Scoring as below.

(6) *Three Squares.*

The paper with the circles on was reversed and the S asked to draw three squares on the other side. Scoring as below :—time in seconds, measures in mm. :

Circles :

Time . . .	N = 9	$M_T = 4.6$	$M_C = 9.7$	$s = 9.8$	P = N.S.
Largest diam. . .	N = 9	$M_T = 19.4$	$M_C = 30.4$	$s = 38.4$	P = N.S.
Smallest diam. . .	N = 9	$M_T = 14.4$	$M_C = 20.7$	$s = 24.6$	P = N.S.
Average diam. . .	N = 9	$M_T = 17.1$	$M_C = 25.8$	$s = 31.6$	P = N.S.

Squares :

Time . . .	N = 9	$M_T = 8.7$	$M_C = 14.4$	$s = 12.1$	P = N.S.
Largest diag. . .	N = 9	$M_T = 28.6$	$M_C = 38.8$	$s = 49.8$	P = N.S.
Smallest diag. . .	N = 9	$M_T = 22.9$	$M_C = 32.2$	$s = 36.0$	P = N.S.
Average diag. . .	N = 9	$M_T = 26.0$	$M_C = 35.3$	$s = 42.4$	P = N.S.

(7) *Estimating Distances.*

The S is asked to indicate what he considered 2-foot distance was by placing two matches two feet apart on the table. Then one foot ; then 8 inches, so that there are four matches on the table. These distances are measured and recorded. Scoring, in quarter-inch units, as below :

Overestimation, 3 tests . . .	N = 7	$M_T = 14.7$	$M_C = 9.1$	$s = 13.3$	P = N.S.
Underestimation, 3 tests . . .	N = 7	$M_T = 4.6$	$M_C = 5.1$	$s = 8.5$	P = N.S.
Error, 8-in. estimate . . .	N = 7	$M_T = 4.0$	$M_C = 3.0$	$s = 3.0$	P = N.S.
„ 1-ft estimate . . .	N = 7	$M_T = 5.3$	$M_C = 4.4$	$s = 5.9$	P = N.S.
„ 2-ft. estimate . . .	N = 7	$M_T = 10.0$	$M_C = 7.0$	$s = 9.2$	P = N.S.
Total error . . .	N = 7	$M_T = 19.3$	$M_C = 14.4$	$s = 16.6$	P = N.S.

(8) *Waves.*

A sheet of foolscap size, squared paper with 4 V's marked at precise places, is given to the S. In each of four trials the S is required, first, with the eyes open, to trace over a V ; then with eyes closed, to make six more V's along the same line and, as far as possible, the same size. The arm is kept up all the while, only the pencil touching the paper. Two scores were derived : for amplitude (average of 1st and last amplitude of 4 sets of waves, i.e., of 8 measures altogether) ; and for wave-length (average wave-lengths of all 4 sets, measured parallel to edge of paper). Measures in mm. :

Amplitude . . .	N = 9	$M_T = 23.3$	$M_C = 23.1$	$s = 3.7$	P = N.S.
Wave-length . . .	N = 9	$M_T = 91.7$	$M_C = 87.1$	$s = 20.5$	P = N.S.

(9) *Reading Prose.*

The subject was asked to read aloud a piece of prose. Score :—time in secs.

$$\text{Time} \quad N = 8 \quad M_T = 28.2 \quad M_C = 26.2 \quad s = 6.0 \quad P = N.S.$$

(10) *Tapping.*

Tapping with a pencil on a sheet of paper for two trials of 15 sec. each. Score: Average number of taps made. Instruction is *not* to tap as fast as possible; score therefore, represents natural tempo rather than maximum rate:

$$N = 9 \quad M_T = 54.8 \quad M_C = 53.4 \quad s = 34.0 \quad P = \text{N.S.}$$

c. *Miscellaneous Tests.*(11) *Body Sway* (Eysenck, 1947).

A simple apparatus of the string and pulley type is arranged to record the S's forward and backward sway. Two scores are obtained: static ataxia, when the maximum forward sway during a 30-sec. period is added to the maximum backward sway, the S being told simply to stand quite still with his eyes closed; and suggestibility, in which the score is maximum backward or maximum forward sway during 1 minute, whichever is the greater, the S being continuously told by the E during this period that he is falling forward:

$$\text{Static ataxia} \quad N = 5 \quad M_T = 2.1 \quad M_C = 0.8 \quad s = 1.7 \quad P = \text{N.S.}$$

$$\text{Suggestibility} \quad N = 5 \quad M_T = +1.9 \quad M_C = +1.0 \quad s = 2.1 \quad P = \text{N.S.}$$

(12)

In this test* an attempt is made to obtain a measure of ideo-motor tendency, the aim of the test being partly disguised. The testees are asked to tell the examiner what certain words mean, the words being chosen because they are suggestive of movement, e.g., rattle, kick, punch, juggle, flinch, throw, etc. There are 21 words, and score consists in the number of words in which any form of gesture, accompanies the definition:

$$N = 5 \quad M_T = 5.8 \quad M_C = 3.6 \quad s = 7.3 \quad P = \text{N.S.}$$

(13) *Perseveration* (Eysenck, 1952).

A quarto-sized sheet of plain paper is placed horizontally in front of the S. He is required to write a series of S's, as many as he can, for 15 seconds (period A), then a series of S's reversed for 15 seconds (period B), followed by a 30-second period (period C) in which he writes alternately one S followed by an S reversed, as many

$$\text{as he can. Score: } \frac{A + B}{C} :$$

$$N = 8 \quad M_T = 1.7 \quad M_C = 1.7 \quad s = 0.7 \quad P = \text{N.S.}$$

(14) *Luria Test.*

The S sits in front of the Luria apparatus and is told that, when a word appears in the aperture in front of him he must respond with the first word that comes into his mind. At the same time he should jab downwards a plate on which his right hand rests. His left hand he is told just to keep resting on the appropriate plate. A 30-word list is used. Continuous records are obtainable: from the right hand (a series of V's, i.e., whenever the S jabs downward, which may be scored for various indices of motor disturbance); from the left hand; and of the time of presentation of the stimulus, and of the time of the verbal response. Scores† as follows:

Right hand:

$$\text{Average width} \quad N = 6 \quad M_T = 1.6 \quad M_C = 1.0 \quad s = 0.6 \quad P = 0.05$$

$$\frac{\text{Range}}{6} \quad N = 6 \quad M_T = 0.2 \quad M_C = 0.0 \quad s = 0.1 \quad P = 0.02$$

$$\text{Average amplitude} \quad N = 5 \quad M_T = 21.0 \quad M_C = 17.7 \quad s = 5.7 \quad P = \text{N.S.}$$

$$\frac{\text{Range}}{6} \quad N = 5 \quad M_T = 0.8 \quad M_C = 0.8 \quad s = 0.6 \quad P = \text{N.S.}$$

$$\text{Number of disturbances}^\ddagger \quad N = 4 \quad M_T = 6.7 \quad M_C = 1.8 \quad s = 8.3 \quad P = \text{N.S.}$$

* Devised by Dr. P. Sainsbury of this Institute.

† The scoring is based on a method devised by Messrs. J. Standen and G. Thorpe of this Institute.

‡ Number of motor disturbances between presentation of stimulus and motor response or during response but not after response.

Number of changes of base line . . .	N = 2	$M_T = 5.5$	$M_C = 4.0$	$s = 13.3$	$P = \text{N.S.}$
Number of motor failures . . .	N = 4	$M_T = 0.5$	$M_C = 0.0$	$s = 1.0$	$P = \text{N.S.}$

Left hand :

Number of distur- bances† . . .	N = 5	$M_T = 8.2$	$M_C = 8.2$	$s = 15.5$	$P = \text{N.S.}$
Average verbal reaction time (mm.) . . .	N = 6	$M_T = 6.2$	$M_C = 5.2$	$s = 2.7$	$P = \text{N.S.}$
$\frac{\text{Range}}{6}$. . .	N = 6	$M_T = 2.3$	$M_C = 2.0$	$s = 1.3$	$P = \text{N.S.}$
Average discrepancy between motor and verbal R.T. (mm.) . . .	N = 6	$M_T = 3.2$	$M_C = 3.8$	$s = 2.9$	$P = \text{N.S.}$
$\frac{\text{Range}}{6}$. . .	N = 6	$M_T = 0.7$	$M_C = 0.8$	$s = 1.1$	$P = \text{N.S.}$

(15) *Level of Aspiration* (Himmelweit, 1947).

The mirror drawing test (Test 2) was also used to get a measure of level of aspiration. The time for the first trial was recorded and the S was asked to guess how long he took (judgment). Also, how long he thought he would take the next time (aspiration). This procedure was repeated for all the trials. Discarding the first trial, three scores were used : average goal discrepancy score (average discrepancy between performance and aspiration) ; average judgment discrepancy score (average discrepancy between performance and judgment) : index of flexibility (number of times the aspiration level was changed).

Goal discrepancy . . .	N = 6	$M_T = +2.2$	$M_C = +14.5$	$s = 8.3$	$P = 0.02$
Judgment discrepancy . . .	N = 6	$M_T = -4.2$	$M_C = +7.3$	$s = 6.7$	$P = 0.01$
Flexibility . . .	N = 6	$M_T = 3.2$	$M_C = 3.5$	$s = 0.8$	$P = \text{N.S.}$

(16) *Rosenzweig P-F Study* (Rosenzweig *et al.*, 1947).

The picture-association study is a projective technique for assessing reactions to frustration. The test consists of a series of pictures of persons in frustrating situations, e.g., being splashed by a car, being woken by the telephone in the night, being stopped by a policeman for a motoring offence, etc. The testee is asked to supply what one person in each situation would say, the assumption being that the testee, consciously or unconsciously, identifies himself with the frustrated individual in each pictured situation and projects his own bias in the replies given. No elaborate scoring was carried out in the present study. Each response in the records of the tiqueurs and controls was simply scored for direction of aggression, using Rosenzweig's Revised Scoring manual in making decisions where possible. The responses were scored E = extrapuniteness (aggression is turned onto the environment) ; I = intropuniteness (aggression is turned by the S upon himself) ; and M = impunitiveness (aggression is evaded in an attempt to gloss over the frustration). Score consists in the total number of each type of response given by the S :

E . N = 3	$M_T = 7.3$	$M_C = 9.3$	$s = 1.8$	$P = \text{N.S.}$
I . N = 3	$M_T = 5.7$	$M_C = 5.0$	$s = 1.8$	$P = \text{N.S.}$
M . N = 3	$M_T = 7.0$	$M_C = 5.7$	$s = 1.2$	$P = \text{N.S.}$

IV. DISCUSSION.

Despite the small numbers, certain findings seem to the writer suggestive. This discussion is based, firstly, on differences which are significant at less than the 10 per cent. level of probability ; and secondly, on groups of differences which, although individually are not significant, are consistently in an expected direction.

The most clearly supported finding is that the tiqueurs are consistently better in their performance on the tests of skilled movement than the controls. On the

† Number of motor disturbances between presentation of stimulus and verbal response.

Dotting and Mirror Drawing tests this difference reaches the usually accepted levels of significance, on the Triple Tester the difference was significant at the 10 per cent. level, and on the R-V Manual Dexterity test the difference, while not significant, was in the same direction. These findings will be discussed in connection with the results from the Luria test.

On the tests of expressive movement no significant differences are found on any measure. Nor are the direction of the changes consistent in any way suggestive of worth-while hypotheses. The battery includes a variety of objectively scorable tests of expressive movement, including tests indicative of expansiveness and speed in drawing simple shapes; tendency to over- or under-estimate distances; a test (Waves) which appears similar to those of Mira (1940); and, lastly, two tests of personal tempo, reading prose and tapping. The variety of tests included makes the more significant the lack of differences in results between the two groups. It seems doubtful whether tiqueurs show peculiarities of expressive movement which are worth investigating further.

Of the remaining tests, the most complex motor test was the Luria test. A variety of measures was taken from this test, but those which appear to be of the greatest interest are those showing disorganization of right-hand voluntary movement. There is no difference between the groups on the measure of left hand involuntary disturbance; and, of the measures making use of reaction times, no consistent findings emerge. Of the seven measures of disorganization of right-hand voluntary movement, two differentiated between the groups significantly, the tiqueurs tending both to make wider V's with the right hand and to be more variable on this measure. The direction of all except one of the remaining five right-hand indices also suggest that the tiqueurs show a greater degree of disorganization, with emotion, of voluntary motor performance than the controls. This finding is of interest when it is remembered that it was also found that the tiqueurs are consistently better in their performance on tests of skilled movement than the controls. Future research should be directed towards finding out what it is in the psycho-physical make-up of tiqueurs which makes both for skill in motor performance and for motor disorganization when under emotional stress. A number of investigators have demonstrated a relationship between muscular tension and motor learning (Hovland, 1951). This finding, together with those of the present study, suggests that the systematic investigation of the relation between muscular tension and tics should prove a fruitful line for future investigation. Both physiological (electromyographic) measures of tension and behavioural measures (psychological tests) should be used. A matched group design is probably the most efficient for exploratory purposes, and tics with a discoverable organic basis should be investigated separately from those resulting from psychological causes. It would also seem wise to use as many measures as possible of tension reactions: tension at rest, tension when under emotional stress and change from resting to stress conditions.* In light of the results from the present investigation, the last of these measures seems especially important.

Of the other motor tests in the battery, three may be mentioned which were included as measures of ideomotor action (i.e., the tendency of an idea, or image, of movement to produce the precise movement imagined or a modified form of it). The strength of this tendency may be expected to be greater in persons who have developed motor disorders, rather than disorders of the other bodily systems. The tests particularly concerned are test 12, where the definitions of words suggestive of movement are asked for, and the suggestibility score on the Body Sway test. The test of static ataxia may also be included here if, as Eysenck (1947) has suggested, this test includes an element of auto-suggestion. Although none of the differences between the groups on these tests are significant, they are all in the same direction, the tiqueurs tending to make more movements when defining words, and to sway more on the Body Sway test whether this is given in the suggestion or non-suggestion form. These measures are, however, crude in their present form. The results need following up using more delicate methods of recording a person's tendency to make movements. At a physiological level the electromyograph would appear suitable, and, at a behavioural level, cine photography. Both techniques have been used in a similar connection by Sainsbury (1952).

* A research, in part along these lines, is being carried out by my colleague, Dr. P. Sainsbury.

Finally, of the motor tests, an interesting negative result is the failure, using the Ss-test, to corroborate Angyal's (1949) finding of a relationship between perseveration and psychomotor symptoms. On this test the performance of the tiqueurs is identical with that of the controls.

On the question of the personality correlates of tics, the clinical literature suggests that tiqueurs may tend to be, what in Eysenck's (1947) terminology is called, of dysthymic temperament. This term is used by him to characterize the syndrome of anxiety, reactive depression and obsessional tendencies, and is defined in terms of objective tests which differentiate groups of dysthymic patients from groups of hysterics. In the present investigation the level of aspiration of the two groups was studied using the Mirror Drawing Test. Dysthymics would be expected to aim high, judge that they had performed poorly and be relatively inflexible in varying their aspirations. In fact, comparing the performance of the tiqueurs with that of the controls, although the second and third of these hypotheses are confirmed (the second at a statistically highly significant level) the first is disproved, also at a statistically significant level. Thus, no clear interpretation of the results of this test is possible. However, there are further lines of evidence in support of the hypothesis that the tiqueurs tend to be of dysthymic temperament. On the Rosenzweig picture-association study, although none of the differences is significant, their direction is such that the tiqueurs tend, compared with the controls, to be intro-punitive, or impunitive rather than extrapunitive, that is, they tend to turn their aggression upon themselves, or to evade the aggression in an attempt to gloss over the frustration rather than turn the aggression on to the environment. Although no direct experimental evidence is available, these traits would appear consistent with the dysthymic temperament. Additional evidence may be cited from two of the tests included primarily as tests of skill, but which are known to be related to temperament. The work of Culpin (1931) strongly suggests that good performance on the Dotting test picks out persons with obsessional tendencies. Petrie (quoted by Eysenck, 1947) has shown that on the O'Connor Tweezers test given in speeded form and similar in principle to the R-V Manual Dexterity test, a dysthymic group correctly placed more pins than a group of hysterics. It may be said, therefore, that the evidence both from the personality and from certain of the motor tests is confirmatory of the hypothesis that tiqueurs tend to be of dysthymic temperament. A follow-up investigation of this temperamental correlate of tics would involve further testing, with a fuller battery of tests known to measure this personality dimension.

V. SUMMARY.

Tests of skilled movement, expressive movement and temperament were administered to a small number of tic patients and to individually matched, but non-tic, control patients. The aim was to see whether any basic psycho-motor or personality traits could be said to characterize the tiqueurs. The results were as follows:

- (1) The tiqueurs were more efficient in their performance on tests of skill. At the same time, their voluntary movement was more easily disorganized under the influence of emotion. These findings suggest that the relationship between muscular tension and tics should be systematically explored.
- (2) On the tests of expressive movement no pattern of performance was found to be characteristic of the tiqueurs.
- (3) The tiqueurs tended to have a greater ideomotor tendency. This finding should be followed up using sensitive physiological and behavioural measures.
- (4) There was confirmation from the test results of the clinical suggestion that the dysthymic temperament is a personality correlate of tics.

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OCCUPATIONAL PSYCHIATRY: AN HISTORICAL SURVEY AND SOME RECENT RESEARCHES.*

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INTRODUCTION.

THE relations between Psychiatry and Occupation are considerable and complex. This is the case whether we consider psychiatry as limited (Curran, 1952) and thus approach the problem through the individual patient and his work, past, present and future, or less limited and thus concerned with industry and group adjustment. In reality both approaches deal with essentially the same basic problem which is the biological adaptation of man to his occupation, or to earning a living. Such work phases form an integral part of man's very existence, whether he works to live, or lives to work. Interest in the maintenance of health through prevention of occupational hazards has developed rapidly in this century, stimulated by war stresses, defence programmes and economic cataclysms. The struggle for our industrial survival has focused more than our interest, as psychiatrists; but extravagant offers of industrial consultancy, of trying to teach where little knowledge is yet available are patently dangerous. Industry, like society, has often been led to expect too much, and too soon, from our as yet embryonic facts, experiments and principles in this field.

Because of the inevitable overlap between social, domestic and occupational influences on health and adjustment, the purist may cavil at the reality of such entities as occupational health or occupational psychiatry. This is not to derogate from the undoubted importance of the theory and practice of occupational medicine. However, when we study man's adaptation within the occupational field we soon find that its specific attributes, hazards and stresses, whether physical or psychological, are intensely real, deserving study and consideration. Occupational psychiatry may therefore be considered part of the socio-medical approach, and thus to comprise on the one hand the social and economic consequences and relations of psychiatric illness, and on the other hand, the occupational factors that cause such maladjustment or affect mental health. I shall deal with these main subdivisions in the historical review.

The last introductory point I wish to stress is that this subject is a branch of medicine in the occupational field, and that it can only develop through, and as part of, the industrial health services. The recent Dale Committee Report on such services showed that "they are important in ensuring that the worker is at least no worse in health as a consequence of his work," contributing to his confidence and so enhancing his work satisfaction; "they are thus an important element in promoting and maintaining good morale in industry" (Cmd. 8170). Now while the larger undertakings have generally provided medical services, the majority of the factories in this country are small; out of a total of some 240,000 factories, some 221,000 employ less than 50 workers, and of these, 203,000 employ less than 25 workers. Full services may be neither practicable nor appropriate, but for some of the smaller undertakings some further service is desirable. The extremely small proportion of the factory population covered by general medical supervision is shown in Table I, viz., 1.04 per cent. of factories.

It is against this realistic background that the provision of psychiatric services to industry must be considered. In the whole of the U.S.A. there are but six full-time psychiatrists in industry, but many more part-time consultants (*G.A.P. Report*, 1951). Here the dearth of psychiatrists in general must preclude such extension, yet the arguments for some factory consultations are considerable, if only to assist in prevention and thus to reduce the case-load in clinic and hospital. Above all, the success of preventive psychiatry in industry must be along educational lines, for

* Paper read at the Annual Meeting of the Royal Medico-Psychological Association, 3 July, 1952, at Northampton.

TABLE I.*—*Factories with Medical Services other than Statutory Examination of Young Persons for Certificates of Fitness (Great Britain).*

	Factories with—					Total.
	Less than 26 workers.	26-50 workers.	51-100 workers.	101-250 workers.	Over 250 workers.	
1. Number of factories in Great Britain						
2. Number of factories with definite arrangements for medical services (other than statutory examinations of young persons) of one or more of the kinds indicated in 3.	202,868 (.42)	18,207 (.45)	10,475 (.43)	7,335 (.75)	4,884 (.48)	243,769 (1.85)
Percentage of Line 1						
3. Kinds of medical services in the factories in 2 (see note (1)):						
(a) General medical supervision over health of employees, including, e.g., study of sickness records, working conditions, and advice to the firm on questions of factory hygiene	845 (.42)	453 (.48)	433 (.43)	750 (.75)	2,018 (.41)	4,499 (1.85)
Percentage of Line 1	230 (.11)	137 (.75)	223 (.21)	418 (5.70)	1,517 (31.06)	2,525 (1.04)

* This table is abstracted from Appendix E of the *Report of a Committee of Enquiry on Industrial Health Services*, Cmd. 8170, H.M.S.O., 1951.

all levels of worker and manager, and for varying sizes of firm (see also Markowe, 1951; Steward, 1947). Should health services be extended to non-industrial establishments as advocated in the Gower's Report (Cmd. 7664) for shops, offices, etc., there will be further problems. A sense of proportion in the deployment of psychiatrists is thus of extreme importance and deserves consideration.

HISTORICAL REVIEW.

(1) *Psychiatric Illness in Relation to Work.*

The occupational consequences and relations of psychiatric illness have been recognized in the psychoses and mental deficiency from the earliest times. The greater part of the training of *defectives* is social and occupational in objective as well as in therapy. Many are able to leave their parent institutions after such care and work usefully in the community, with apparently no greater susceptibility to monotony than the normal worker, nor undue accident proneness. My colleagues in London have shown that it is possible to predict the occupational adjustment of high-grade defectives by means of a battery of personality tests with a considerable degree of success (O'Connor and Tizard, 1951). In the case of the *psychoses* various aspects of occupational therapy have been practised from time immemorial, receiving renewed emphasis by hospital reformers, and culminating in recent years in the development of specialized departments and therapists. The stress on therapy rather than on diversion, and on vocation rather than on therapy, must surely be a changing one in the light of increased patient turnover from improved methods of treatment. This is not only a technical problem for psychiatrists in conjunction with occupational therapists and disablement resettlement officers, but equally an educational one for the community, for employers and workers alike to accept the increased numbers of ex-mental hospital patients in the labour force.

Awareness of the occupational relations and consequences of *neurotic illness* has been a development of this century, due partly to the growth of extra-mural psychiatry and partly to the increasing scope of preventive medicine in industry. Some three streams can be discerned in these modern trends. *First*, surveys within the working community, were carried out by Culpin and May Smith (1930), Halliday (1935) on insured workers in Scotland, Wyatt (1945) on certified sickness absence among 30,000 women in munition factories, and the Russell Fraser team (1947). The latter has been the most extensive study of the incidence of neurosis among factory workers yet carried out, in the war years 1942-3; its findings are too well known to be repeated at this meeting. Criticisms that may be levelled against the continued citation of its findings as representative of factory workers to-day include its wartime study, the domestic stresses and separation of many of the workers, the selected nature of the industry studied and the weight given to sociability as an index of mental health. Nevertheless the incidence of such mental ill-health in industry is considerable; it is responsible for much absenteeism (Fraser, Wyatt), labour turnover and unemployment (Lewis, 1934), a poor production both in quality and quantity, accidents (Selling), and the exaggeration and prolongation of incapacity, in addition to impaired human relations on the job (Tredgold, 1949). *Second*, the study of industrial accidents and accident neuroses has thrown much light on the minority of workers usually responsible for most of the accidents in a given group. The same people usually exhibit the highest sickness rate and signs of neurotic instability. Clinical studies revealing the close association between accident proneness and neurotic illness have been well summarized by Flanders Dunbar (1948). Russell Davis (1948), in discussing these relationships, draws attention to the fact that of the various forms of neurotic reaction to a threatening environment, only certain of these reactions impair skill and thus predispose to accident. He considers that the psychoanalytical theory of unconscious motivation of accidents can be neither denied nor proved, although activity responsible for accidents is rarely characterized by organized patterns of behaviour. The dissolution of skill in relation to pilot error is well brought out in this publication. In regard to the accident or compensation neuroses, social and legislative advances have helped in ameliorating unhealthy attitudes by repealing the Workmen's Compensation Act, with its attendant legal and medical controversy in open court, protracted litigation and unnecessary accentuation of damages and compensation. However, it remains to be seen whether the substitution of benefits and pensions for compensation may not in fact counterbalance many of the more desirable features of the new industrial

injuries insurance and its complementary rehabilitation and disabled persons' employment machinery. The issue is indeed a complex one; social policy and humanitarian motives favour a weekly benefit or pension, while psychiatric aims would probably be best furthered by an early and final award of damages as at common law. The *third* stream is that of rehabilitation and resettlement, and arises partly as a reaction to the first two—surveys and accident problems. Beginning between the wars, and determined partly by the realization that medicine and surgery without measures to return the sick or injured as effective workers were performing an incomplete job, rehabilitation methods and ideas grew. Much valuable experience was used from the more progressive mental hospitals and institutions. It was, however, in the recent war that any considerable extension of such centres and services became manifest in general out-patient work. The recommendations by the Tomlinson Committee for dealing with disablement on a wide basis, and for integrating rehabilitation and vocational centres, were a far-sighted progressive step in social medicine, and were implemented by the Disabled Persons (Employment) Act, 1944. I need only refer to the growth of the independent Roffey Park Centre in the last decade with its clinical, teaching and research functions (Ling, Purser and Rees, 1950), Belmont Industrial Neuroses Unit (Maxwell Jones, 1949) with its group diagnostic and therapeutic techniques, and Bierer's Day Hospital. In this connection the dangers of removing neurotic patients from their work, unless they are extremely ill, must be considered. A recent report on the value of staying on the job may here be mentioned. Kalinowski (1950), reviewing the end-results of removing patients from external stress, both military and industrial, and compensating them with pensions, with the later German practice of holding men to their responsibilities, concludes that untold harm is often done by the former. Neurotic illness may not only be aggravated by withdrawal but by transfer. Do we really possess sufficient knowledge to advise change of job, or that equally dangerous prescription of light work? Would not a better appreciation of occupational factors and their effects be a necessary preliminary to true occupational therapy?

(2) *Developments within Industry.*

(a) *Social Economic and Political.*

Historians have shown how economic forces effect social changes, and how the combination of both produces in its turn political and legislative repercussions. Even a bird's-eye view of industry must include glimpses of how daily conditions of work have altered. In the early middle ages master, journeyman and apprentices worked, lived and ate together, finding happiness through pride in their craft. By the 14th century, however, the master craftsman had become the "boss," organizing production and distribution, while the journeyman was relegated to the rank of manual worker with few opportunities for promotion except perhaps by marrying the employer's daughter. A further rift developed within the ranks of the masters, between the rich merchants and the poor craftsmen. The guilds and craft brotherhoods fell under the control of small exclusive groups, and also created friendly societies for the relief of accident victims, the sick and the aged. Accompanying such developments was that of Mutual Aid (Beveridge, 1948)—the traditional reaction of workers to overcome difficulties by combination in trade unions and by co-operation. In most respects this form of self-help was a direct outcome of the upheavals of the industrial and agricultural revolutions, when vast sections of the population were driven from their social moorings in the countryside and small towns into the ports and manufacturing centres. There both factory and slum developed side by side, with the accompanying slave traffic in pauper children, long hours for all, squalor and degradation in mill, workshop and mine. Such conditions fostered the humanitarian conscience in those zealous reformers of the 18th and early 19th centuries typified by Robert Owen, Edwin Chadwick, the Earl of Shaftesbury, as well as the great novelists and poets. Protective legislation led to minimum standards of health, welfare and safety, curtailment of hours of work, and the State inspection of factories. Later improvements were essentially in connection with the eradication of toxic and other hazards in industry, with accident control and with the development of State insurance against incapacity arising out of working conditions. Such facts are far from being mere historical data; these attempts on the part of our society to regulate conditions of work and so to improve health and efficiency are as important to the tranquillity of mind of the worker and so to his

better adjustment as are the more recent excursions of social psychology into group tensions and harmonies. There has been far too much tendency in the last few years to assume that prior to the Hawthorne "discovery" of the importance of human factors in industry, interest and progress had been purely technological with almost complete neglect of social and psychological factors. I hope I have indicated that from the beginnings of the industrial era there has been a gradual growth of technical, social and welfare measures to safeguard and promote the health of the worker.

The delicate balance in trade unionism between constructive forces eager to participate in the drive for increased production while maintaining living standards and the legacy of hostility, suspicion, and distrust, is one that should attract research. Similarly the many problems raised by nationalization and the consequent remote control at the periphery, with loss of initiative and responsibility, call for investigation and solution (Robson, 1952). In all these facets of the industrial complex I am sure you would agree that psychiatric insight can help to unravel if not to remedy, but only with scientific humility and by painstaking research in the field, not by armchair theorizing.

(b) *Early Scientific Applications.*

Improvements in technical work methods to lighten the physical load of the worker, to protect him from the dangers of the machine or from toxic materials, began fairly early in the industrial era, and still continue to-day. Apart from isolated observations of human behaviour at work, such as Leonardo da Vinci's study of the rhythm of movements in different trades, the calculation of energy expenditure by physicists, Lavoisier's study of effort by analysing expired air, there was little scientific interest until towards the end of the nineteenth century. Yet here was the field of occupation, which absorbed the greater part of man's activity and so often shaped his whole existence for better or for worse. Physiologists began their laboratory studies of movement and fatigue, while engineers applied stop-watches and cameras in order to realize their goal of human mechanical efficiency, through the abuse of time and motion study. It must be admitted that their methods helped to eliminate much fatigue, to regulate the rhythm and duration of work and rest cycles, to systematize wages and management (Lee, F. S., 1918). Shorn of the excessive claims of some efficiency experts it will be seen that the methods of Taylor and Gilbreth began the more scientific study of work and management, in an attempt not only to improve efficiency but to satisfy human needs.

(c) *Occupational Psychology.*

Another scientific stream now emerges, the psychological one of vocational guidance. It is true that Plato's principal ordinance in *The Republic* included "giving to his citizens their employment according to their nature," and that Montaigne had remarked how seldom the most important decision of a lifetime, namely the choice of a career, was guided or informed. Yet no systematic guidance was attempted until Frank Persons inspired the Boston Bureau in 1908, and Hugo Münsterberg applied the Binet-Simon tests to various aptitudes at Harvard in 1912 (Münsterberg, H., 1913). In this country the earliest administrative attempt to advise and offer jobs to workers was in 1909, when Mr. Winston Churchill inaugurated local Labour Exchanges, with an associated Juvenile Employment Service in the following year. Now it was soon realized that jobs should be neither too hard nor too easy, if the worker is to enjoy a satisfying life of value to the community. Further, opportunity should always be available for using an individual's skills, and for developing his potentialities to the utmost whether through work or leisure. This presupposes not only active co-operation of teachers, parents and employers with the Youth Employment Service (reconstituted in 1948), but also the collection of reliable information about school-leavers and about jobs, and passing the latter data to the schools. Schools are now required to provide details about the health, ability, educational attainments and aptitudes, temperament and home background (almost the whole of the N.I.I.P. 7-point scale). But until we can reduce the 33,000 primary schools with over 40 pupils per class (and the 29,000 secondary schools with over 30 per class) there is not much chance of teachers producing reports of much value in vocational guidance. However, we must hope that useful reports are available at least in the case of those handicapped pupils who are

educationally subnormal, maladjusted or epileptic. Assuming then the potential reliability of collecting adequate data about school-leavers (with the help of the school health service and guidance clinics where necessary), how valuable is the advice and guidance that can be offered? In the Birmingham research (Hunt and Smith, 1944), as a result of following up 1,630 children over a period of 2 years, and 608 over a period of 4 years, it was shown that systematic assessment followed by acceptance of the advice given resulted in greater happiness, stability and effectiveness at the job than where only routine guidance was given. Similarly researches carried out on behalf of the National Institute of Industrial Psychology since 1921, and the Industrial Health Research Board over the same period, would claim equal success for organized and scientific vocational guidance (Burt, 1924; Earle, 1935; Oakley and Macrae, 1937; Farmers and Chambers, 1936; Rodger, 1937). Whether such guided individuals would still be satisfactorily settled after 10 or 20 years is not known. On the job side of the picture careers pamphlets have been issued in profusion, but there is still no systematic knowledge available of the main aptitudes, attainments, intelligence, temperament and physical demands of different jobs. Greater progress has been made in the United States Employment Service both in job classification and analysis, and in the recent compendium by Hanman (1951) on *Physical Capacities and Job Placement*. The latter distinguishes between physical (in which he includes emotional) limitations and occupational handicap, and stresses the importance of the positive approach in terms of abilities rather than disabilities. With this most physicians and psychiatrists would agree, but it is his "specific" rating method in terms of some 40 physical and 31 environmental factors that appears rather formidable. There is an unfortunate neglect of psychological factors which tends to give this system a "human" engineering appearance. In any event the changing political and social situation is so potent a force, both in vocational choice and adaptation, that except in periods of relative trade tranquillity (alas, rarely the norm in our generation) it is the economic wind that tends to blow the majority of the semi- and unskilled workers from job to job. Satisfactory adaptation to work depends on so many non-measurable factors—cultural, geographical, domestic, marital and financial, quite apart from the human problems on and through the job, that serious doubt may be thrown on the validity of many prediction claims based solely on psychometric procedures.

(d) *Recent Trends.*

Social services were introduced by a few progressive firms towards the end of last century partly as a substitute for the personal relations previously existing between employer and employed, and partly to promote the workers' welfare in and out of working hours. Allied with these were the developing industrial medical services already referred to, and introduced primarily for the economic motives of reducing loss through injury and disease at work. With the extensions of social insurance these factory medical services were latterly relieved of all except urgent and accidental cases and became mainly preventive in outlook. At the same time increasing awareness of the importance of social and psychological factors in health began to stimulate industrial doctors to collaborate with management and workers in the detection of monotony and fatigue, in the effects of good and bad supervision, in safety and in guidance programmes. Much interest was fostered by the series of invaluable research reports of the Industrial Health Research Board, dating from the early work on fatigue in munition workers in World War I, and by the applied research and teaching of the National Institute of Industrial Psychology. Then American interest was aroused by the findings of the Hawthorne investigators, who, beginning with an investigation on the effects of varying illumination on production, soon became aware of the overriding importance of social, domestic and psychological factors (Mayo, 1933; Roethlisberger and Dickson, 1939). Out of this grew the policy of employee "counselling" and also "joint consultation," by which the employees' share and sense of responsibility was increased. Such participation through works councils and committees is of intense importance in raising morale and thus the mental health of the group, and in the ventilation of grievances (D. E. Cameron, 1945).

Further developments in social psychology, in morale and leadership occurred during World War II, when psychiatrists and psychologists applied their newer techniques both in the armed services and in industry. Considerable advances were

shown in personnel selection (Vernon and Parry, 1949), in officer selection (Rodger, 1948; Harris, 1949), and above all in attempts to apply the lessons of service experience to social and industrial life after the war (Rees, 1945; Menninger, 1948; Tredgold, 1948). Insights gained into group dynamics stimulated advances in group diagnosis and therapy, and led to the development of new techniques in social research, as by the Tavistock Institute of Human Relations (Wilson, 1951; Jacques, 1951). The importance of the foreman, his selection, training and status have been carefully discussed in a recent publication which emphasizes the key position he holds to-day (*N.I.I.P.*, 1951). Medical claims to a part in the selection and training of supervisors and managers have been previously submitted to this Association by Steward in 1947. An impressive and ambitious programme has been recommended to the World Federation for Mental Health by its sub-group on Mental Health in Industry (W.F.M.H., 1950).

Enough has been said to indicate the many forces moulding the beginnings of occupational psychiatry; it is only history that can supply its content. The scope and limitations of the subject have been adequately dealt with in the recent report on the Application of Psychiatry to Industry issued last year by the Group for the Advancement of Psychiatry.

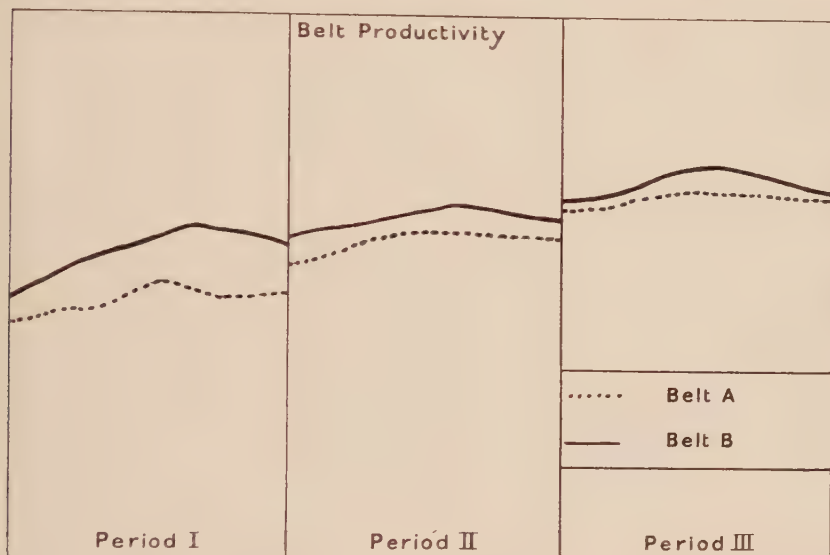
SOME RECENT RESEARCHES.

I now propose to review three investigations carried out in the Unit for Research in Occupational Adaptation (of the Medical Research Council) by its Manchester Team. Awareness of the incidence of neurotic and other forms of psychological handicap in industry had suggested the need for studying such persons at work; to discover how, in fact, they adapted themselves to their jobs and their fellow workers, and the influence they had on the health and efficiency of the working group. A multi-disciplined approach was obviously indicated, and the team as eventually constituted consisted of a psychiatrist, a psychologist and an economist.

The methodological difficulties are considerable, whether from the point of view of acceptance by industry, or from the more technical aspects of assessing mental health or handicap on the one hand, and effectiveness on the job on the other. It will be apparent that to select a group of patients already diagnosed or under treatment at a clinic, to follow them into industry and then to compare their productivity and adjustment with those of a group of so-called normal controls is an almost insuperable task. The number of groups within factories engaged on comparable work with uniform or preferably the same supervision is surprisingly limited. Again, acceptance by managements when one cannot offer therapy or solution of particular problems, and when some loss of production time is inevitable, must be doubtful, unless there is already a tradition of public service or support of research into the human factor. This naturally makes one's findings limited from the point of view of generalization. When we consider co-operation by the subjects it will be obvious that their suspicions must be legion—not only in relation to psychology and psychiatry, but always to the lurking fear of management in the background and a natural and understandable reluctance to being investigated. The medical setting was always stressed, and the more obvious spheres of emotional and cultural resistance were avoided. After a general review of the life-history, with particular note of work record and attitude, ratings were made of mental and physical health, and various personality traits such as maturity, persistence, affective lability, anxiety, timidity and obsessionality; physical details included measures of cardiovascular efficiency, haemoglobin, blood-pressure, height and weight, and where necessary a clinical examination. Interview time and examination were reduced to a minimum, usually about 1 hour, and the confidential nature of the inquiry stressed at every opportunity. There were obvious deficiencies in such assessments, especially as reliance was necessary on uncorroborated stories; there was no question of social or home visiting, nor of the inclusion of objective data from the work situation, against which the health assessments were to be studied. Likewise the psychologist's difficulties—especially in measuring neurotic tendencies; much of his test battery was in the experimental stage. Little normative data was available in the orectic field that was applicable to unskilled industrial workers. The economist's problems in measuring output were surprisingly almost as complex and uncertain as our own. Above all, our findings are based on relatively small numbers of normal groups in everyday factories; they should be considered cumulatively.

In *Project I* the relations between the medical and psychological characteristics and the industrial effectiveness of two independent and parallel groups of workers were investigated. Both groups were engaged in final assembly, and comprised some 28 apparently healthy men and women and a charge-hand. The charge-hands were responsible to the same foreman. Each member of the two groups was examined medically and psychologically, and these findings were considered in relation to group output and absenteeism over three periods of 10 weeks. The groups cannot be considered as random collections—they had in fact been continuously selected by management and supervision.

During the first period assessments of productivity were made before the groups were aware of the project; Group B was slightly more productive than Group A (see graph). In the second period, while the workers were interviewed and examined



Tension syndrome.

and research interest became apparent, there was a suggestive rise in the output of both groups, but the less effective Group A was relatively more influenced by these factors. Before the third period the charge-hands were transposed in order to measure the effect of changed supervision; both groups increased their output, but the difference between group average was reduced compared with the first period, although Group B remained the more productive group throughout all the three periods. Now psychologically Group B was the healthier, contained more stable, emotionally mature, and less anxious persons than Group A; and further, it showed greater friendliness and was more closely knit than A. These findings thus support the generally accepted view that industrial effectiveness is related to the health of the group.

The hypothesis that differences in output are related to the health and personality of the charge-hands was tested by the exchange of charge-hands. Charge-hand A was suffering from a mild anxiety state and was emotionally unstable—a lean, hard-pressed man who required his foreman's support in day-to-day problems; while B was a bluff, self-sufficient autocrat. These personality differences in the supervisors appear to be closely related to the industrial effectiveness of their respective groups, and the higher output of both groups consequent on the exchange of the charge-hands in the third period. Since, however, both groups showed this improvement, it may possibly have been due to the effects of being investigated—the so-called Hawthorne effect.

Contrary to expectation, the group which was less healthy and industrially less effective had less absenteeism than the other; thus in this study absenteeism was

related to a higher standard of occupational adjustment. Lastly, the industrial effectiveness of the group appeared to be more dependent on the homogeneity than on the range of abilities of its members (Markowe and Barber, 1952).

This study emphasized many research problems in this particular field, not only because of the lack of adequate methods of health and personality assessment at work, but also because of the no less difficult task of measuring variations in output. We therefore attempted to simplify our productivity measurement problems in *Project II* by studying an entire group of 80 grid-casters, individual piece-workers in the same factory. These workers were chosen as the largest group of workers in the factory engaged on essentially similar operations, whose past records were available and comparable over long periods; they were neither sampled nor selected. These men, all over 21, were investigated clinically, psychometrically and by social inquiry to determine economic and industrial experience. The medical and psychological findings were set against criteria of each man's adjustment to occupational demands. These criteria were essentially output during a period of 67 weeks prior to the commencement of the investigation, absenteeism during the calendar year 1949, and ratings of "job-adjustment" on a five-point scale made by six different supervisors on each of two occasions five weeks apart (Heron, 1952).

The ages of the men ranged from 22 to 64, and their experience in this department from 1 to 30 years. In regard to recent mental health, 20 out of the 80 were considered subnormal, 3 of them markedly so. The range of intelligence of the whole group was extensive, but the average was lower than in soldiers. Subgroupings were then made in terms of the industrial criteria on the one hand (i.e., the highest and the lowest decile in each case), and of the health and psychological criteria on the other. When they were divided into groups according to their industrial performance, no clear medical and psychological characteristics emerged to account for their differing work records. Their personality and health, however, showed some relationship to output and adjustment in the less satisfactory groups. Those whose productivity was less than average and whose job-adjustment was poor were introverted, of rather low intelligence, without ambition and with a history of frequent changes of job. It must, however, be remembered that productivity has an artificial "ceiling" imposed by the workers themselves.

Classifying the men according to their mental stability and intelligence revealed that those who had a poor record of recent mental health combined with low intelligence had as a group an average output, and, in every case but one, were rated by the supervisors as well-adjusted to their job. Of the individuals, however, who had low intelligence with average recent mental health, two-thirds had a low productive output (although one such man, of obsessional habits, had as good a production record as anyone in the whole 80).

The negative findings were even more informative than the positive ones. The more intelligent men did not produce more than the dull ones, nor were those who produced least men with rather poor mental health. Social influences operating outside the factory played a larger part, it appeared, in determining output than the mental health of the individual: Thus men whose income was supplemented by children at work or by domestic occupation, such as keeping poultry, or who had reduced domestic responsibilities, produced fewer grids than the average.

The most favourable supervisors' ratings of adjustment were generally given to the older and more experienced workers, which is quite understandable. The low ratings were mainly for the normally healthy workers; there was certainly no preponderance of clinical neurotics. There was further indication that extraversion militated against a favourable rating.

Certain widely held beliefs were not confirmed. Thus younger workers were absent more frequently but for shorter periods than the older; domestic and social reasons were as relevant as medical and psychological ones. Recent mental health ratings were, in the most absent group, normal or slightly below. Although it has been urged that piece-rates intended as incentives have an adverse effect on the neurotic worker, increasing his feelings of insecurity (Dawson, 1950), this was the case in only 2 out of the 20 workers found below normal in their mental health. In general the assumption that workers who have a psychological handicap such as neurosis or poor intelligence often fit badly into industry and produce less than the average worker was *not confirmed* (Markowe and Barber, 1953).

Labour turnover is another industrial problem that invites study in connection with our field of work. Industrialists and economists pursue the elusive grass-

hoppers for their own reasons; we wished to study the importance or otherwise of psychological handicap in this connection. Therefore in *Project III*, a random sample of 100 men and 100 women was studied out of the total intake of a well-known engineering factory, between March and November, 1951. This project consisted in a series of initial clinical interviews where recent mental health was assessed, and then a follow-up of each of these 200 workers for 6 months, in order to estimate not only whether or not they stuck to their allotted jobs, but also how well they adjusted. I can only give the barest details, since the final check on the last of the subjects was only recently completed.

We found that 52 of the 100 women had left by 6 months; as compared with 21 of the men; much of the former turnover was no doubt due to domestic pressure. A striking fact was that in these groups the distribution of mental health ratings among leavers and non-leavers was at first sight different; this difference proved on statistical analysis to be significant only for the men. However, when the psychologically handicapped were compared with those in the normal range as regards leaving before or after 10 weeks, it was found that in neither sex was there a significant tendency for the handicapped to leave earlier, as is generally assumed. This may be due to neurotics clinging to the job as long as possible, or on the other hand, to normals enjoying greater independence and freedom in the rapidly changing labour market.

CONCLUSIONS.

I have tried to give you a brief account of our own investigations, and also to show the importance of history in the field of occupational psychiatry. It may well be asked if these studies have given any definite results of practical application. I think it can be said *firstly* that psychological disability is by no means synonymous with occupational disability; and *secondly*, that neurotics when working individually give as good an occupational performance in the groups studied as the average unskilled worker, whether in terms of production, fitting in, or staying on the job. The implications of such findings in our present production crisis are obvious. Finally, in this vast field of occupation in which so many millions of men and women are involved, psychiatry is needed not only in its clinical and research functions, but above all, educationally.

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THE USE OF ELECTROPLEXY IN MENTAL DISEASE WITH CLOUDING OF CONSCIOUSNESS.

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CLOUDING of consciousness is a common feature of organic psychoses. It may be of any degree of severity from acute delirium to some diminished capacity for clear thinking and impairment of retention for recent experiences. However, such a diminution in the level of awareness also occurs occasionally in "functional" mental disorders; severe and rapidly evolving attacks of mania or depression may be associated with some degree of clouding of consciousness, and Meduna in some recent papers (Meduna and McCulloch, 1945; Meduna, 1950) has redirected attention to "oneirophrenia," an acute psychotic disorder originally described by Mayer-Gross (1924) in which clouding of consciousness is the general rule.

The possibility of an organic factor in causation needs always to be investigated in the presence of such a clouding of the sensorium. If a physical illness is in fact discovered, or where it has been known to exist from the beginning, treatment must naturally be directed first towards its elimination. However, both diagnosis and treatment may present problems of some difficulty (*a*) when a psychosis continues after spontaneous or therapeutic termination of the illness in the course of which it originally developed; (*b*) when a psychosis commences after recovery from a toxic or infective illness; and (*c*) when an illness whose clinical picture and natural history strongly suggest an affective or schizophrenic psychosis is complicated by some clouding of consciousness. The presence of some degree of constitutional disturbance in the form of mild pyrexia and tachycardia which is common in such cases (in addition to clouding of the sensorium which may be present in variable degree in all three kinds of case) makes it difficult to exclude the possibility that some unidentified toxic factor is at any rate partly responsible for the continuation of the illness.

The problem of treatment in such cases is one of some difficulty. For in a case of acute affective disorder, E.C.T. could be expected to terminate or alleviate the attack; but in the face of some impairment of awareness, memory and orientation, there is a natural reluctance to use a procedure itself liable in excessive dosage to produce these defects. Yet leaving such cases to take their natural course is fraught with some risk, as severe "confusion" (in the sense of clouding of consciousness) is a serious complication in any mental disorder, especially in the old; restlessness and starvation may bring about rapid exhaustion, and even a fatal issue is not uncommon. It is therefore of particular importance to know that E.C.T. has been used with safety and success in many cases of psychosis complicated by clouding of consciousness.

Some of the cases described in the literature would appear to have been symptomatic psychoses, others acute confusional states without any specific cause (Delay and Maillard, 1945, 1946; Delay, 1946). However, E.C.T. has also been used effectively for psychotic symptoms of frankly organic origin such as those associated with G.P.I., epilepsy, pernicious anaemia, and pellagra (Ewald and Haddenbrock, 1942; Kalinowsky and Kennedy, 1943; Delay, 1946; Fernandes and Polonio, 1946; Bini, 1947; Yaskin, 1948; Kalinowsky, 1949; Lopez Ibor, 1950). These reports are of considerable theoretical as well as practical importance, but relatively little attention appears to have been paid to them in this country. We have therefore thought it desirable to place on record the following account of eight cases of

psychosis with clouding of consciousness in which E.C.T. was used with success, and to use our experience as a starting-point for a discussion of the significance of the reports published on the use of E.C.T. in organic psychoses.

CASE RECORDS.

CASE 1: *Mrs. M. G—, housewife, aged 54.*—The patient had a history of chronic cholecystitis of two years' duration. She was admitted to a general hospital on 11.vi.51 during an exacerbation of symptoms. The physical state improved with conservative measures, but on 13.vi.51 she became withdrawn, confused and restless. She was transferred to mental hospital on the following day and was then completely disorientated. For the greater part of the time she sat in bed with her hands clasped above her head. She resisted passively all forms of attention and refused to swallow. The simplest question elicited a nonsensical answer. Left to herself, the patient muttered incoherently and appeared to be both visually and aurally hallucinated. Abnormal physical findings were limited to faint icterus, a raised E.S.R. (30 mm.), moderate leucocytosis, râles at the lung bases. The patient was given 300,000 units distaquaine-penicillin twice daily, and fluids were administered by tube-feed. By 19.vi.51 confusion showed no sign of clearing spontaneously and E.C.T. was started. On the following day the patient was restless and tore sheets and clothing. The second treatment was given on 21.vi.51 and improvement was seen a few hours later. Next day Mrs. G— was fully orientated, pleasant and co-operative, but quiet and subdued. A further convulsion was given on 25.vi.51 and thereafter the patient was active and cheerful. She was discharged recovered on 13.vii.51.

CASE 2: *Mrs. M. W—, housewife, aged 40.*—She was inclined to be highly strung, excitable and sensitive, and was given to worrying over trifles. In childhood she had been neglected by irresponsible parents and was somewhat backward at school. Her marriage had, however, been happy, and had brought out assets such as a capacity for hard work, devotion, and a gift for friendship with people. Following each of her two pregnancies she had been very ill (pleurisy, venous thrombosis); a third pregnancy was terminated at three months and the patient was sterilized. She had had four previous attacks of lobar pneumonia, and on 16.viii.50 she again developed pain on the left side of the chest. Physical signs of consolidation were confirmed by X ray and she was treated with penicillin. On 21.viii.50, when the signs of consolidation were subsiding and the pyrexia had ceased, she was described as having become restless, interfering, confused, and deluded about the other patients and the nurses in the medical ward to which she had been admitted. Her conduct disturbed her fellow-patients, and she was transferred to mental hospital on 28.viii.50 under Urgency Order. On admission she was completely disorientated and out of contact. Her upper limbs carried out manneristic movements and her face was contorted in bizarre grimaces; her talk was incoherent. She made secret-significant gestures and addressed herself to God, as if He were in her presence. E.C.T. was commenced on 1.ix.50. After three treatments she was composed, rational, and able to give a good account of herself. During the course of seven E.C.T., which ended on 19.ix.50, she continued to improve, becoming more composed, aware of her surroundings and less toxic in her appearance. She made a complete recovery, but had a total amnesia for the acute phase of her illness. She was discharged on 4.x.50.

CASE 3: *Mrs. J. C—, housewife, aged 42.*—The patient had been happily married for 22 years and had a healthy family of seven. She was good-natured, sociable and efficient. In 1943, while her husband was overseas, she had a brief period of depression which remitted without hospital treatment. About three months prior to admission to mental hospital she was worried by a pain over her heart. She was given a "tonic" by her doctor and the pain and anxiety disappeared; she continued to take the medicine. In March, 1949, her attitude towards her husband became less friendly. Soon afterwards she openly accused him of theft, infidelity, and attempting to poison her. It was noticed that she had become forgetful and repetitive. The patient was admitted on 25.iv.49. Physical abnormalities included dilated pupils reacting sluggishly to light, marked tremor of the tongue and hands, and exaggerated tendon reflexes. She was restless, noisy and agitated. Her thought content was devoted to her husband's misdemeanours; everyday events were put forward as indisputable evidence of his crimes. The systematization of her delusions was obscured by incoherence and thought disorder. Defects of attention, retention and recall were prominent and she was disorientated for time. The serum bromide was found to be 250 mgm./100 ml. Routine treatment by sodium chloride, fluids and sedation was started. By 3.v.49 the serum bromide had fallen to 201 mgm./100 ml., but the patient remained agitated. Her paranoid ideation extended to include most of her fellow-patients and the staff. She misinterpreted every action, found sinister significance in commonplace objects, and accused the nurses of poisoning her. As her condition was deteriorating in spite of a falling blood bromide, E.C.T. was started. A dramatic improvement followed the second convulsion. She became quite cheerful and composed, and paranoid delusions faded into the background; only a slight lability of affect remained. By 17.v.49, after six convulsions, the serum bromide was 83 mgm./100 ml. After one further treatment on 21.v.49 electroplexy was discontinued. The

patient was then cheerful and stable. She smilingly denied persecutory ideas and spoke of her husband with affection and appreciation. She remained well, and was discharged recovered on 3.vi.49.

CASE 4: *Mrs. E. T—, housewife, aged 36.*—The history of the patient's life before illness was negative, except for several months' tension and irritability after the birth of the youngest of her three children, nine years previously. In the summer of 1947 the patient complained of lack of energy, and "rheumatism." Her appetite had been poor for some time and this feature became more marked. She had been greatly attached to her father, and her condition worsened after his death in January, 1948. There were increasing irritability, restlessness, insomnia, vague somatic complaints and unjustified accusations of cruelty on her husband's part. She was admitted to hospital on 13.ii.48 and was found to be emaciated (weight = 6 st. 3 lb.) and hypertensive (B.P. = 180/120). No contact could be made with her. Occasionally she would nod or shake her head in response to persistent questioning. From time to time she moaned and whined. She was in bed for long periods; her head, limbs and trunk were in constant, purposeless, writhing movement, accompanied by grotesque facial contortions. When on her feet the movements would continue until interrupted by sudden complete muscular relaxation and she flopped on the floor. This puppet-like behaviour was best seen when she was being supported; left to herself she walked without difficulty. She refused food, and micturated on the ward floor in the presence of fellow-patients. E.C.T. began on 16.ii.48. After the second convulsion the patient answered questions for the first time, but her replies were meagre and wide of the mark and showed her to be grossly disorientated. Destructive behaviour and stereotyped hyperkinesis continued until after her fourth fit. On 26.ii.48, after six E.C.T., she was rational, orientated, co-operative and composed. Amnesia blotted out the acute phase of her illness and obscured many events occurring during the weeks before admission. She showed embarrassment when explaining that she had thought that a holy war was going to begin after Gandhi's death. At this stage the patient still looked toxic, and a labial herpetiform eruption was noted. B.P. was 156/84. At the beginning of March she became unco-operative, restless, over-talkative and confused. This relapse was aborted by three E.C.T. By 18.iii.48 she was very well mentally and was again affectionate towards her husband. She had gained 14 lb. in weight. A few days later signs of relapse reappeared and electroplexy was again resorted to, with rapid improvement. It was decided to improve her state of nutrition by modified insulin therapy, which was started on 24.iii.48 and continued until 30.iv.48. During this her behaviour remained relatively normal; she produced no psychotic ideas, but appeared to have slight emotional blunting. B.P. on 3.v.48 was 184/110. Later in the month she appeared to be well, but complained of lack of energy and showed ambivalence towards her husband. On 12.vi.48 she returned home on trial holiday. Her husband reported that she was mildly irritable and quick-tempered, but considered that these were normal features of her personality. At the time of her discharge, 14.vii.48 she had gained 35 lb. in weight.

CASE 5: *Mrs. M. J—, housewife, aged 43.*—Healthy, lively and intelligent in her earlier days, she had a good school record and a successful career as a nurse. She was ill-treated by her husband, from whom she had been separated for years. She was placid, good-tempered, and devoted to her family of three. After her last parturition, 15 years previously, her weight had steadily increased. In April, 1949, on returning from the wedding of her eldest son, she was exhausted and depressed, expressed ideas of self-reproach, showed apprehension and tension, and slept poorly. Fleeting episodes of confusion were noticed. She was admitted to hospital on 9.v.49, and presented a widely fluctuating clinical picture with day-to-day changes in mood, sensorium and the thought processes. Affect fluctuated from perplexity to extreme agitation. At times she was disorientated and grossly confused, at times showed only retardation, defects of retention and recall, and impaired conceptual thinking. Memory for recent events was always impaired. Weight on admission was 16 st. 9 lb. Apart from this obesity and a 17-ketosteroid output of 22.4 mgm./24 hours, no gross abnormality was found in any physical system, although the blood bromide, urea and cholesterol were investigated in addition to a full clinical examination. On 16.v.49 pyrexia to 101° F. began, and continued at a slightly lower level until 30.v.49, in spite of courses of penicillin and sulphathiazole. No septic focus could be discovered. The patient became more constantly agitated, destroyed clothing and gave vent to strident and stereotyped self-recrimination. Little contact could be made with her. Treatment by sedation and massive doses of the vitamin B complex brought no improvement, and E.C.T. was given on 24.vi.49. A distinct change was noted after the second convulsion. At the sixth treatment, on 5.vii.49, the patient was fully orientated, quiet, composed and friendly; diurnal sedation could be reduced to a minimal level. The course of nine E.C.T. was concluded on 16.vii.49, and convalescence was uneventful. The patient was discharged recovered on 13.viii.49.

CASE 6: *Mrs. G. R—, housewife, aged 54.*—The patient showed a degree of timidity in childhood, but had a normal school career and worked happily and efficiently as a domestic servant. She had been happily married for 14 years. She was cheerful, active and friendly, although inclined to worry needlessly. Her health had been good, except that there was a vague story of "heart trouble" before marriage. Her illness began in April, 1949, with

anxiety, pressure of talk, increased domestic activity and hypsomnia. These symptoms worsened until on 8.viii.49 she abused and struck her husband and rushed out into the street in her night attire. She returned before her husband could catch her and then locked him out of the house, shouting and singing the while. Thereafter there was a brief period of comparative normality, and then further restlessness, pressure of activity, singing, and dwelling on events of the remote past. Admitted to hospital on 15.viii.49 she looked thin, haggard and toxic. No gross abnormality was found in any physical system. Peripheral arteriosclerosis was not marked, and the B.P. was 130/86. An E.E.G. recording on 17.viii.49 showed features often found in toxic states; the alpha rhythm was obscured by a persistent low voltage, fast beta rhythm, most pronounced in the parieto-occipital areas. For long periods the patient would lie motionless, staring in front of her; suddenly she would burst into song or declaim passages from the Bible in a shrill crescendo. She constantly identified the staff as close relations. She was irritable and distractable, and the slightest provocation roused acute paranoid excitement. In such episodes she shouted obscenities at the staff and accused them of poisoning her. There were brief periods of relative lucidity when she was quiet, submissive and apologetic, and able to describe her previous disturbed behaviour although not with complete insight. E.C.T. was started on 17.viii.49 and repeated on the following day. By 24.viii.49 she was lucid and much quieter. A course of eight E.C.T. was terminated on 4.ix.49, by which time the patient showed no psychotic features but was tense and inclined to seek frequent reassurance. There was increasing confusion during the following two weeks, with anxiety and mild depression. She constantly mislaid articles and became paranoid when they could not be found. She was given mild diurnal sedation. On 25.ix.49 her B.P. was found to be 200/100. Thereafter confusion with restlessness and disorientation for place and time increased. She wandered round the ward with a vacant stare and accosted all comers, refused food for fear of poisoning, made accusations of stealing, and besought the doctor not to send her to a nunnery. As her agitation was increasing, electroplexy was recommenced on 11.x.49, but after the first few fits treatments were spaced at 5-day intervals. After the fourth convulsion she again became rational and purposeful, although still fussy about her personal belongings. The second course of eight treatments finished on 4.xi.49, by which time no psychotic symptoms remained. During convalescence she remained cheerful and active, although undue timidity could be seen from time to time. She was discharged recovered on 17.xii.49.

CASE 7: *Miss J. M.—, housewife, aged 40.*—The patient had always been quiet and reserved. She had worked as a nursemaid and housemaid and for five years during the war served with the Red Cross; thereafter she stayed at home caring for her widowed mother. During the past year she had been keeping company with a man for the first time. They had hoped to marry, but the patient's mother could not be left alone. For a few weeks before admission sleep had been less satisfactory than usual. Two days before admission the patient had fleeting episodes of agitation in which she showed perplexity and foreboding. On the next day she was confused and agitated, asking for her father, who had died during her infancy. She attempted to go for a walk in her night-clothes, and when prevented, tried to jump through a window. She became abusive and violent when interviewed by her doctor, and was with difficulty sent to hospital on 5.vii.49. On arrival she was wildly excited and resistive. She rocked herself to and fro muttering "What's happening? Why is the world like this?" Though she was now normally orientated she had a complete amnesia for the preceding two days. Little contact could be made with her during the next few days. Her demeanour was one of inarticulate misery and she seemed unaware of her surroundings. Occasionally she whispered, "I seem to have got mixed up somehow. I can't get it right." With difficulty she was spoon-fed. E.C.T. began on 10.vii.49 and convulsions were given on three consecutive days. On 13.vii.49 her temperature rose to 100.8° F., reaching a normal level two days later. No physical abnormality save obstinate constipation could be detected. The patient was less restless and agitated, but showed little spontaneity and considerable perplexity. Electroplexy was resumed on 19.vii.49. After the fifth convulsion she was cheerful, friendly and composed. Amnesia blotted out the acute phase of her illness. She was able to give an accurate outline of her past career; she denied that her courtship or its future prospects had been a source of anxiety to her. A course of eight E.C.T. was completed on 1.viii.49, by which date the patient appeared to be very well. A fortnight later she was unduly concerned about trivial matters, e.g., losing a thimble, but further investigation showed that post-convulsive amnesia had caused greater anxiety than any material loss. When this cleared she remained well, and was discharged recovered on 23.ix.49.

CASE 8: *Mrs. R. T.—, housewife, aged 56.*—The patient had always enjoyed good health, and her personality showed no neurotic traits. She had recently been concerned about her husband's ill-health and her son's welfare while on active service. She conducted the family hairdressing business during her husband's indisposition. Two weeks prior to admission she became sleepless, restless and agitated, and expressed delusions of poverty. A few days later she began to shout, sing and dance, and refused all nourishment. After admission on 16.i.47 she was depressed, sullen and suspicious. She was treated by three leptazol convulsions followed by four E.C.T. and was discharged recovered on 9.iii.47. She remained well until September, 1948, when she became anxious over trivial matters. She soon

developed loosely-connected paranoid ideas and extreme agitation. On readmission on 1.x.48 she was almost stuporose. E.C.T. again brought rapid improvement and the patient was discharged on 12.xii.48. She was then noted to be facile and had only superficial insight. Her remission lasted only a fortnight, and she returned to hospital on 27.i.49, again depressed and sub-stuporose. As before, E.C.T. roused her from this state to apparent normality, but again for no longer than a fortnight. Treatment was repeated with similar results. In April, 1949, the unusual features in this case became more prominent and suggested the possibility of presenile dementia. The patient shuffled slowly about the ward, staring fixedly at her fellows. She adopted peculiar fixed postures and mumbled constantly to herself. From time to time a vacant grin spread slowly over her features. From this state she could be roused to give the date, her whereabouts, name and address, but not the doctor's name. Later in the month the euphoric smile vanished; she had to be spoon-fed; she could be roused only for a few seconds to make a wrong guess at the day of the week. On 6.v.49 she was noted to be carrying out bizarre, stereotyped movements with her hands and to be muttering incessantly a stream of incoherent jargon. She had a wild, mad stare and was completely out of contact. After careful consideration it was felt that, in spite of the transformation of the clinical picture, a change in diagnosis in a case of recurrent affective disorder should not be decided on without a therapeutic test. E.C.T. was therefore recommenced; after seven E.C.T. the patient made a remarkable recovery, her facial expression was bright and alert, she was quickly responsive to all stimuli, fully orientated, interested in her ward-mates, and free from all delusions. At the same time she exhibited emotional facility and was garrulous. Although E.C.T. could reverse the clinical picture in this case, the result was transient. The patient's progress during the following months is a record of relapse to a state resembling dementia followed by restoration to apparent normality. When it became clear that no permanent amelioration could be hoped for from electroplexy, a prefrontal leucotomy was carried out on 27.x.49. After some early inertia she made uninterrupted progress to a stable recovery from her psychosis. The previous finding of emotional shallowness was still present after operation, but to no more marked an extent. At the time of the patient's discharge on 19.ii.50 her husband considered that she was completely her former self again. She has resumed work in the family hairdressing business.

DISCUSSION.

The cases do not form a homogeneous group. Cases 1 and 2 were precipitated by an acute infective illness, while in Case 3 a specific organic factor, bromide intoxication, was demonstrated as a cause. In Cases 4 and 5 no definite infective or toxic factor was isolated, but the extreme emaciation and toxic appearance of 4, the severe constitutional disturbance and fluctuating clinical picture in 5, and the marked clouding of consciousness in both, make it probable that they were psychoses of the toxic-infective group. Case 6 may have had an acute affective psychosis of the "mixed" variety, but the severity of the affective disturbance did not seem adequate to account for the clouding of consciousness, which thus introduced the possibility of some subsidiary organic cause. Case 7 may likewise have suffered from an atypical affective disorder, but here again the lability of the clinical picture, and the confusion and patchy amnesia for acute phases of the mental illness, made it impossible to exclude an organic factor in causation. Case 8 was undoubtedly one of manic-depressive psychosis, but severe clouding of consciousness so transformed the clinical picture in later attacks that the possibility of some organic disease of the brain arose. This case teaches the important lesson that a change in the clinical features of a mental illness does not by itself warrant the revision of a firmly established diagnosis of affective disorder; one should be cautious about a change of diagnosis from a recurrent but reversible illness to a progressive, irreversible one, and only the strongest evidence justifies it.

All eight patients were women, but this was probably due to the fact that during most of the period in which they were observed, each of us was in charge of female wards.

The first seven cases described were probably suffering from a psychosis that was wholly or in part toxic-infective in character; the clinical picture in all eight raised the possibility that unidentified infective or toxic agents had contributed in causation or were partly responsible for perpetuating the condition. With the exception of the last case, the group as a whole is in many respects comparable with the cases described by Delay and his co-workers in their papers on "les syndromes confusionnels." The aetiology and precise nosological status of such conditions present problems of some complexity into which we do not wish to enter here. We are concerned mainly with the difficult decisions these cases present for treatment.

Our experience has confirmed that of other writers we have quoted; if an acute

psychotic disturbance continues after the physical illness which gave rise to it has been dealt with, or if no aetiological agent can be discovered after full investigation for such a mental illness, E.C.T. is a safe and effective treatment. In the case of an old and restless patient it may be a life-saving measure.

The efficacy of convulsive treatment in the cases described raises the wider problem of the effect of E.C.T. on organic psychoses in general. This is a large subject to which full consideration cannot be given here, but the opportunity afforded by the study of our cases will be taken to summarize some of the recent findings, since they have great theoretical as well as practical significance. Fernandes and Polonio (1946) have reported the successful use of E.C.T. in a number of psychoses of clearly organic aetiology. Thus it terminated akinetic states associated with pellagra which failed to recover after treatment with nicotinic acid. An hallucinatory paranoid state in pernicious anaemia, which persisted after treatment with liver had produced a normal blood picture, likewise responded to it. E.C.T. has also been described as effective in the treatment of withdrawal symptoms in morphine addicts (Kalinowsky, 1949; Lopez Ibor, 1950), the fulminating and often fatal catatonia of Stauder (Ewald and Haddenbrock, 1942; Lopez Ibor, 1950), and the acute psychotic disturbances of mental defectives.

In all these conditions the organic factor in causation is either unknown (as, for example, in "fatal" catatonia), or it had been eliminated by the time treatment had begun. Even more unexpected is the effect produced by E.C.T. on mental disorders caused by a specific organic factor that continues to be active. Thus it has been described as largely effective in delirium tremens (Delay, 1946; Lopez Ibor, 1950), and it has been known for some time that in the epileptic fugues and twilight states, in which severe E.E.G. abnormalities are nearly always demonstrable, electrically induced convulsions rapidly bring the condition to an end (Kalinowsky and Kennedy, 1943; Delay, 1946; Fernandes and Polonio, 1946). In general paralysis acute psychotic symptoms are relieved, and severely disturbed patients may be rendered capable of co-operating in treatment with penicillin or malaria. Manic-depressive and in some cases confusional symptoms, hallucinations and delusions that persist after specific treatment also respond frequently to E.C.T. (Ewald and Haddenbrock, 1942; Bini, 1947; Solomon *et al*, 1948; Yaskin, 1948; Kalinowsky, 1949; Lopez Ibor, 1950). However, there is nothing to suggest that negative symptoms such as dementia or emotional facility are influenced, and the infection itself is unaffected, for the serology and neurological signs remain unchanged. There is therefore no justification for using E.C.T. until the infection has been treated with penicillin and/or malaria unless the patient is so grossly disturbed that he is in danger of exhaustion, or so unco-operative that specific treatment is effectively prevented.

An attempt has been made by Delay (1946) to account for the unexpected efficacy of E.C.T. in psychoses with clouding of consciousness. Consciousness as we know it in man, according to Delay, is merely the function of vigilance or awareness of lower animals at a higher level of development. In this light the level of consciousness can be described along a quantitative scale that extends from coma, through less profound states of impairment such as delirium and confusion, and more superficially again through mild impairment of grasp, to normal vigilance. This conception* of delirium and confusion as stages along the path of dissolution of consciousness or vigilance is illuminating, though it cannot be accepted without considerable qualification. It may be objected, for example, that the delirious patient cannot be aroused like the dreamer with whom Delay compares him. If, however, we postulate a second factor which, in addition to reducing his level of consciousness, immobilizes him at a transitional stage between sleep and full awareness, we come somewhat closer to understanding why he can be neither aroused nor easily sent to sleep; insomnia and nocturnal restlessness are, as is well known, almost invariable in delirium.

Delay believes that E.C.T. influences the "commutator" of consciousness in the diencephalon, thus rectifying the impairment of consciousness, and the patient, rendered normally aware of his environment, ceases to behave as if in a dream. There is, in fact, much evidence to indicate that the control of consciousness is maintained from the diencephalon, as also that the therapeutic effects of E.C.T. are to be attributed to an influence upon diencephalic centres (Delay, 1946; Roth, 1951

* A restatement, as Delay makes clear, of a view implicit in the writings of earlier authors.

and 1952). However, if such an explanation is adopted in the case of confusion, a somewhat different mode of action must be postulated for E.C.T. in affective psychoses and schizophrenia, while still further explanations must be invoked to account for its influence on organic psychoses such as general paralysis and pellagra.

We believe that more cogent explanations for the unexpected action of E.C.T. in organic psychoses may be derived from an examination of the range of clinical conditions in which E.C.T. has been shown to be more or less effective. It becomes evident at once that E.C.T. is a non-specific treatment, for it influences clinical phenomena of opposite sign such as mania and depression, stupor and hyperactivity, agitation and apathy, and conditions as varied in causation as schizophrenia, epileptic twilight states and the symptomatic and organic psychoses described or referred to above.

It is difficult to conceive of aetiological factors common to such a very wide range of disorders. The only physio-pathological factors common to them are those of a most general kind; they are all qualitatively new patterns of behaviour superimposed upon those established in the individual before illness. In view of the rapidity with which E.C.T. tends to eliminate them and the completeness with which premorbid behaviour is restored, it is also unlikely that they are derived (directly at any rate) from structural changes in brain cells of a kind demonstrable by our present methods of investigation. It may be objected that its action in the organic psychoses can hardly be used as a further argument for the non-specificity of convulsive treatment, as it does not really counteract the effects exerted by the organic agent on the brain, but merely the depressive or schizophrenic components of the organic picture which may be regarded as the reaction of a predisposed constitution. However, confusion, which as we have seen is often reversed by E.C.T., is certainly not a response confined to individuals with a specific predisposition for it. Nor are depressive and other functional symptoms totally independent of the organic agents with which they may be associated. Thus it has been shown that if the syphilis is untreated, the "functional" symptoms in a general paralytic tend to relapse rapidly after convulsive treatment (Broggi, 1937; Solomon *et al.*, 1948). Further evidence that E.C.T. does in fact tend to counteract some of the effects of organic agents on the brain is provided by the observation that in acute confusional episodes due to toxic factors that are still active, the effects of E.C.T. are transient, and relapse continues until they have been dealt with (Delay and Maillard, 1945). E.C.T. may therefore be legitimately claimed to act not only in functional psychoses of varied causation, but to some extent also in organically determined mental disorders.

This non-specific character of convulsive treatment suggests that it is unlikely to act directly upon the causes of psychiatric disorders for which they are used but (like other markedly non-specific treatments such as ACTH and cortisone) upon the regulating and defensive mechanisms of the organism which may be mobilised into activity against them. There is much evidence in support of this view. It is well known that during a course of E.C.T. the patients treated exhibit rapid changes in sleep rhythm, appetite, weight, and menstruation, which are probably due to an influence on the diencephalic centres regulating these functions. Altschule *et al.* (1948) have shown that E.C.T. evokes the whole syndrome of neurohypophyseal activity. The rapid changes in the electrical activity of the brain are also due probably to a primary influence on the diencephalon, and may have a homeostatic action (Roth, 1951, 1952). Such a mobilization of the activity of cerebral centres concerned with homeostasis could be expected to exert a non-specific effect, for regulators should correct different kinds of derangement of stable conditions.

In the light of this argument the action of E.C.T. on the symptomatic psychoses we have described and the organic psychoses cited from the literature may be attributed to a *tendency* to abolish or impede behaviour patterns that are as yet poorly assimilated into the basic patterns characteristic of the individual personality, and to promote the establishment of the most stable and integrated organization of activities of which the brain remains potentially capable. Theoretically, E.C.T. could therefore be expected to produce some effect on all illnesses imposing *qualitatively new* patterns of behaviour not due to structural alterations in the brain. (Evidently basic patterns of behaviour cannot be restored if their anatomical foundation no longer exists.) This provides no grounds for the indiscriminate use of E.C.T. In the first place the effect produced may be far too transient, trivial or uncertain to justify the risks incurred, and the anxiety and discomfort

suffered by the patient. Moreover, it will be obvious, on commonsense grounds (and apart from any consideration of duration of effects), that no psychosis should be given a non-specific physical treatment until the organic factors in causation have been dealt with as far as possible, or the presence of such factors excluded by thorough investigation. This last statement requires a minor qualification because in rare acute psychoses such as the fatal catatonia of Stauder, the presence of a severe constitutional disturbance may lead to an undue prolongation of fruitless investigations so that the life of the patient is endangered; in such cases E.C.T. would appear to be a life-saving measure, and should not be delayed until all the remote possibilities in diagnosis have been excluded.

As to the details of the physiological processes by means of which E.C.T. exerts the effects described on confusional states among other psychoses, we have as yet little knowledge. It is of interest, however, that some authors (Delay and Maillard, 1946; Delay, 1946) have described a fall in temperature and blood urea and a decrease in leucocytosis during the treatment of acute delirious states with E.C.T. Moreover, it is known from the work of Richter and his associates (Richter and Dawson, 1948; Dawson and Richter, 1950) among others, that there are dramatic, though transient alterations in the biochemistry of the brain following the administration of an electric shock to the head in animals. The most striking and sustained physiological changes known, however, are those to be observed in the E.E.G., and it has been suggested (Roth, 1951, 1952) that the very slow and simple electrical rhythm imposed on the brain by E.C.T. acts with a selective severity upon the engrams subserving behaviour patterns not as yet integrated into the mental apparatus of the individual.

The non-specificity of convulsive treatments should make us cautious in drawing inferences, as Ewald and Haddenbrock (1942) have done for schizophrenia, about the aetiology of the mental disorders in which they are effective. The wide range of conditions in which convulsive treatments have an application rather underlines our ignorance of the nature of the specific causes of such conditions as schizophrenia and manic-depressive psychosis, and lends urgency to the quest for their identification.

SUMMARY.

1. An account is given of eight cases of mental disorder with clouding of consciousness, in which electroplexy was successfully used, and the literature dealing with the use of E.C.T. in organic psychoses is reviewed.

2. Our experience confirms that of other authors; E.C.T. is a safe and effective treatment in acute confusional psychoses with clouding of consciousness if the physical illness that may have precipitated the condition has subsided or has been eliminated by treatment. In some cases clouding of consciousness and constitutional disturbance suggest a toxic or infective cause, but none may be identified even after detailed investigation; if the patient's mental state gives cause for concern E.C.T. is fully justified, and has either an enduring or a temporary therapeutic effect.

3. The theoretical implications of the findings for the problem of the mode of action of E.C.T. are discussed.

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ELECTRICAL TERMINATION OF HYPOGLYCAEMIC COMA.

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PROLONGED cerebral electrostimulation of subconvulsive intensity has been employed as an experimental procedure at this hospital during the past year, and the indications for this technique in the treatment of mental disorders are being investigated. Preliminary tests in conjunction with Dr. H. Weil-Malherbe showed that electrostimulation, when applied to normoglycaemic patients under pentothal anaesthesia, caused a pronounced increase in the concentration of adrenaline-like substances in the blood during the passage of the current. The same current was therefore applied to a series of patients in hypoglycaemic coma to determine whether the effects obtained after injection of glutamic acid—and considered by Weil-Malherbe (1949) to be adrenergic in origin—could also be obtained after electrostimulation. The results of these investigations are presented in this report. The stimulating current employed for this purpose was of the "square wave" (interrupted galvanic) type, which was first applied as a cerebral stimulus by Leduc (1902) in his pioneer demonstration of electrical anaesthesia and sleep. More recently Liberson (1945) has investigated this type of current in relation to E.C.T., subsequently utilizing it in his Brief Stimulus Technique (Liberson, 1947, 1948). This latter technique is also under investigation here at the present time, the same stimulator being used for both convulsive and sub-convulsive therapies; the results obtained with the Brief Stimulus convulsive therapy will be presented in a later report.

THE ELECTROTECHNIQUES.

Since the presentation by Hirschfeld in 1949 of his preliminary report on "Non-Convulsive Electro-Stimulation" a wide variety of important claims have been made for this procedure. Hirschfeld's technique (1949, 1950) employs a unidirectional, pulsed current of low intensity, which is applied to the head by means of small electrodes placed bitemporally about one inch above each ear. By this means he believes that he is producing a selective stimulation of the diencephalic area. For his earlier investigations Hirschfeld utilized the complex modulated current developed by Reiter (cit. Wilcox, 1948), the level of average current employed being about 5 mA for two to five minutes of stimulation time, and he reported good results with this technique in a variety of mental disorders. Since then much work has been done in America on the applications of this procedure using this type of current. More recently Hirschfeld and Bell (1951) have claimed satisfactory results using rectangular impulses of the type employed by Liberson (1947) in his Brief Stimulus Technique of E.C.T. These two types of current differ from the standard mains a.c., which is used in the "classical" Cerletti-Bini electroplexy, in that they are composed of brief, unidirectional spikes or waves, such that the total quantity of current required to produce a response is many times less. This physiological efficiency is achieved on the one hand by using pulses of duration approximately equal to the chronaxie of the cortical motor neurones and with intervals compatible with their refractory period (Liberson's technique); on the other hand the impulses are modulated both in frequency and in amplitude in order to obtain a greater summation of response (Reiter's technique).

Prior to these reports Riboli and Mancini (1948) investigated the neuro-vegetative effects of cerebral stimulation by means of standard alternating current of low voltage; they noted that the resulting blood-sugar curve was similar to that following electroshock. Applying this type of stimulus to patients in hypoglycaemic coma, Riboli (1948, 1950) reported that currents of the order of 30–80 mA given for five to fifteen minutes decreased the depth of coma and frequently aroused the patients, and he presented much evidence that a rise in the blood-sugar level was the principal factor concerned. He also, however, postulated the existence of some other complementary hypothalamic mechanism in order to explain his success in those cases of prolonged coma which had failed to awaken despite administration of glucose to

the point of hyperglycaemia, but which returned rapidly to a state of consciousness following electrostimulation. More recently Hoffman and Wunsch (1950) reported similar experiments using Hirschfeld's technique with a Reiter electrostimulator, and employing a current level of the order of 3 to 4 mA of average current applied for a set time of five minutes. In their series of twelve investigations these workers reported no change in the depth of coma in only one instance; on four occasions the patient aroused completely, and on the remaining seven occasions the coma was superseded by a state of semi-consciousness. They found no uniform correlation between the clinical response of the patient and the change in the blood-sugar level, and they concluded that diencephalic stimulation alone was the primary factor responsible, regardless of any secondary effect on the hypoglycaemia. As an extreme example they reported that one of their cases was fully aroused and talking rationally with a blood-sugar concentration as low as 7 mgm. per cent.

APPARATUS.

The stimulator employed in these investigations was constructed by the writer, and was designed to give a constant current output similar to that used by Liberson (1947), i.e., unidirectional, rectangular pulses of brief duration. The pulse duration is variable between 300 microseconds and 2 milliseconds, and a choice of two frequencies is available, namely 50 and 100 p.p.s., by using either half-wave or full-wave rectification of the a.c. mains on the pulse-forming circuit. As a standard practice the higher repetition rate is used, since Liberson (1945) has demonstrated that this is nearer the optimal frequency for cerebral excitation. Similarly, for subconvulsive application the shortest available pulse duration of 300 microseconds is currently employed by the author, since this entails the minimal expenditure of current quantity. These conditions fix the pulse interval at 9.7 milliseconds and give a mark : space ratio of 1 : 32. In theory, therefore, when the average current flowing is equivalent to 1 mA of continuous d.c., the pulse peak current will be 32 mA. In actual fact oscillographic calibration determined that under the above conditions of frequency and pulse duration the ratio of the peak current to the average current as indicated by a milliammeter in the output circuit was 35 : 1. The discrepancy between this figure and the value calculated theoretically is due to a combination of errors from the following sources :-

(i) Imperfections in the wave form : The theoretical value is calculated on the assumption that the impulses are pure rectangles and does not take into account their times of rise and decay, whereas the oscillographic analysis of the wave form determined that, although the increment was in fact negligible for pulses of all durations the decrement was of the order of 30 microseconds for a pulse duration of 300 microseconds.

(ii) Variations in the frequency of alternation of the mains, upon which the repetition rate depends.

(iii) A d.c. milliammeter in the output circuit may not give an exact measure of the continuous d.c. equivalent of a pulsed current. It was determined, however, that this index was valid as a relative measure of intensity, i.e., doubling the peak current did in fact double the average value indicated. In this manner a straight-line representation of this relationship was plotted for each value of the pulse duration at each frequency.

In the subsequent text and in the tables the current level will be indicated by the average value as measured with a d.c. milliammeter, unless the pulse peak is specifically stated.

The same apparatus is also equipped with glissando and timing devices to enable it to cover the whole range of the stimulatory therapies, convulsive, subconvulsive and combined. These details, however, are irrelevant to the present purpose. In the preliminary trials of the subconvulsive technique circular stainless steel electrodes 2 cm. in diameter were used, but it soon became apparent that either prolonged or frequently repeated applications of the current gave rise to burning of the underlying skin. Subsequently larger electrodes 3 cm. in diameter, also of stainless steel, have been employed and no further complication of this type has been encountered.

METHODS.

The subjects of this investigation were fourteen schizophrenic patients selected at random from those receiving insulin-coma therapy. Six of these were male and

eight were female, with ages ranging from 20 to 49 years. In addition clinical results alone obtained in three other female patients are also reported. The insulin was given intramuscularly and the dosage was individually adjusted to produce hypoglycaemic coma three to four hours after the injection; it varied from 42 to 208 units. In judging the presence of coma the criteria given by Küppers and quoted by Sargent and Slater (1948) were employed, i.e., the loss of all purposive responses to auditory, visual and painful stimuli. The patients were allowed to remain in coma for at least twenty minutes before stimulation was commenced. The stimulating current was applied bitemporally through electrodes of 3 cm. diameter placed one inch above each ear, and with two exceptions the stimulation was maintained for an arbitrary period of five minutes; on the other two occasions this period was extended to ten minutes. A repetition rate of 100 pulses per second with a pulse duration of 300 microseconds was employed in every case. A gag or rubber airway was inserted between the teeth to prevent possible injury to the tongue by the trismus induced by the current. In the first few investigations the current was increased gradually at the onset until the tonic muscular contractions induced began noticeably to impede the respiratory movements and was then adjusted to allow freedom of respirations. This level was most frequently found to occur when the average current flowing was as low as 1 d.c. milliampere, equivalent to a peak current of 35 mA. Subsequently, when it appeared desirable to use higher currents, it was found necessary to modify the technique by raising the initial intensity more rapidly to about 4 mA and then reducing it after fifteen seconds to the required level. This almost invariably produced a total cessation of respirations during the initial induction, but, on reducing the current, respirations were resumed at a greater intensity of stimulation by this method than could be attained with the former technique. During the period of stimulation there were generalized tonic contractions, sometimes moderate restlessness, and the respirations, when resumed, were shallow but forceful, noisy and greatly increased in rate. With continued stimulation, however, there was a tendency for the motor response to diminish and the respirations to become more peaceful, and, when the current was discontinued, even those patients who remained in coma appeared more flaccid, relaxed and quiet. Those who returned to consciousness did so rapidly, and usually without passing through the transition stage of noise and restlessness which characteristically follows a nasal feed.

A patient was considered to have aroused from coma if he responded purposively when spoken to, for example, by opening his eyes or by a turning of the head in the direction of the voice. In actual fact this response was usually verbal and was often a rational and coherent reply. Nevertheless, it frequently occurred that a patient, although apparently fully conscious, was still unable to drink. These cases invariably returned rapidly to a state of coma. On this basis the clinical responses to electrostimulation have been divided into three categories according to the degree of return of the patient to consciousness during the subsequent fifteen minutes. The three categories are defined as follows :-

1. Complete response: The patient aroused sufficiently to drink from a cup enough glucose to remain awake. Denoted by + in the table of results.
2. Partial response: The patient responded to questions but was not able to drink sufficiently to prevent a return to coma. Denoted by (+) in the table.
3. Remained in coma: No purposive response to auditory, visual or painful stimuli for fifteen minutes after the current was switched off. At the end of this period these cases were roused by tube-feed in the usual manner. Denoted by — in the table.

For each investigation five specimens of capillary blood were obtained from the lobe of the ear and blood-sugar estimations were carried out on these by Nelson's method. The specimens were taken at the following intervals: Ten minutes and again immediately before the onset of stimulation, then immediately after, five minutes after, and finally ten minutes after switching off the current. In a few experiments a specimen was taken during the period of stimulation, about three minutes after the onset, and on these occasions the sample normally taken five minutes after stimulation was generally omitted. In cases that aroused sufficiently to drink glucose the last blood sample was omitted if more than five minutes had elapsed since the patient started to drink. Without this precaution false results might easily have been obtained.

The possibility was considered that positive results obtained by the electrostimulation might be due, not to any direct action of the current on the brain centres, but indirectly through the stimulation of pain receptors in the skin and subcutaneous tissues, even though the patient is not conscious of the pain. Control tests, designed to minimize the passage of the current through the brain, were therefore carried out on the same patients on different days by placing both electrodes on the same side of the head, and repeating the investigations under otherwise identical conditions of current intensity and duration. In this manner the localization of the stimulus, i.e., the skin sensitivity, was adequately controlled; on the other hand, the possibility that a not inconsiderable proportion of the current did in fact penetrate the cranium cannot be eliminated. Because of this, little import can be attached to any similarity of result in the two series; on the other hand, any significant difference between the two will indicate a central action of the current in the test experiments. The two sets of conditions adopted will be defined for future reference as follows:

(a) Transcerebral stimulation (test series), using bitemporal electrodes one inch above each ear. Denoted by a "B" in the tables.

(b) Unilateral stimulation (control series), by applying both electrodes one inch apart to the same temporal region. Denoted by a "U" in the tables.

RESULTS.

In a preliminary series of patients specimens of venous blood were withdrawn at various intervals before, during and after electrostimulation, and estimations of the blood-sugar content and of the concentration of the catechol amines (combined adrenaline and noradrenaline) were carried out. The latter estimations were performed by a method developed in this hospital by Weil-Malherbe and Bone (1952) and the results have been reported by them. In the same communication these authors also reported that owing to an error of technique the blood-sugar estimations performed on these specimens subsequently proved to be unreliable. This series, therefore, will not be included here except to mention that there were two cases of complete response, six cases of partial response, and that on a further six occasions the patients remained in coma. The current levels used in this series were in general low, the majority of patients receiving 1 mA for five minutes.

A second series of patients was subsequently investigated and the clinical and biochemical results obtained in this group are shown in Cases 1-14 in Table I, in which each patient is represented by a number and each investigation by the following letter. Cases 15-17 were the only three patients in the preliminary series to receive the control tests and the clinical results only are therefore included. The results reported in Table I will be analysed from three different aspects: firstly, the clinical effects alone; secondly, a comparison of the test with the control series on the basis of the blood-sugar curves; and thirdly, the correlation of the clinical effects with the biochemical changes.

Clinical Effects.

The clinical results of forty-four investigations are reported in Table I, and these may be subdivided according to the degree of clinical response as follows:

	Transcerebral stimulation. (Number of cases.)	Unilateral stimulation. ✖ (Number of cases.)
Complete response . . .	8	3
Partial response . . .	9	3
Remained in coma . . .	8	13

It can be seen immediately that when transcerebral stimulation was employed approximately one-third of the responses occurred in each category. The current level varied in these investigations between 1 and 4 mA, which was maintained for an arbitrary period of five minutes on all except two occasions (Cases 2c and 3b) when the time was doubled. So it would not be unreasonable to suppose that the positive results occurred in response to the higher intensities of stimulation and vice versa. To take these varied conditions into account the clinical effects have been further subdivided on the basis of the current levels used, and for each category of response the mean quantity of current applied has been calculated. This is shown

in Table II, from which it can be noted that those who did not respond to trans-cerebral stimulation did in fact receive a greater average quantity of current than those who aroused.

The numbers in each category are small, especially in the control series, but it would appear from this that the clinical effects obtained were not solely a function of the current quantity administered. With regard to the unilateral method of

TABLE I.—*Effects of Cerebral Electrostimulation during Hypoglycaemic Coma.*

Case.	Age and sex.	Duration of coma (mins.).	Current (mA.).	Duration of stimulation (mins.).	Electrode position.	Blood sugar (mgm. per cent.).						Clinical result.
						10 minutes before stim.	Immediately before stim.	During stim. (3 mins.).	Immediately after stim.	5 minutes after stim.	10 minutes after stim.	
1a	30 M.	40	3	5	B	13	11	9	..	14	9	—
1b		45	3	5	B	12	15	..	31	38	..	+
1c		45	3	5	U	1	6	..	7	18	..	+
2a	31 M.	45	1½	5	B	5	6	..	19	21	7	—
2b		45	1½	5	U	6	7	..	11	15	7	—
2c		35	1½	10	B	10	9	18	22	17	14	(+)
3a	49 M.	30	3	5	B	20	19	..	25	29	27	—
3b		30	4	10	B	18	19	..	27	26	21	—
4a	23 M.	30	3	5	B	11	10	..	29	52	..	+
4b		35	3	5	U	17	21	..	45	39	30	(+)
5a	31 M.	40	2½	5	B	5	6	..	22	25	..	+
5b		35	2½	5	U	5	6	..	9	19	18	(+)
6a	26 M.	40	3	5	B	11	10	..	15	26	25	(+)
6b		35	3	5	U	20	21	..	34	27	25	(+)
7a	20 F.	30	2	5	B	8	10	..	27	42	..	+
7b		35	2	5	B	7	7	5	13	..	18	(+)
7c		35	2	5	U	6	6	8	5	..	6	—
8a	37 F.	40	2	5	B	18	18	..	25	29	..	+
8b		50	2½	5	B	5	4	7	24	..	19	+
8c		40	2½	5	U	7	7	7	9	..	8	—
9a	31 F.	30	2½	5	B	12	13	..	21	25	20	—
9b		45	2½	5	U	10	11	..	18	16	13	—
9c		30	2½	5	B	8	10	..	14	18	16	—
9d		50	2½	5	U	6	8	..	8	8	7	—
10a	38 F.	50	2½	5	B	1	2	..	19	24	11	—
10b		45	2½	5	U	6	5	..	8	13	8	—
10c		35	3	5	B	2	3	..	12	20	13	(+)
10d		40	3	5	U	10	11	..	15	15	11	—
11a	42 F.	30	2	5	B	18	20	..	31	..	..	+
11b		30	2	5	U	18	20	..	26	..	..	+
11c		25	2	5	B	11	13	..	24	33	24	(+)
11d		30	2	5	U	5	5	..	17	14	11	—
12a	30 F.	25	3	5	B	7	5	..	18	25	15	—
12b		30	3	5	U	9	10	..	19	20	9	—
13a	30 F.	25	2½	5	B	12	13	..	27	32	28	(+)
13b		30	2½	5	U	27	29	..	37	39	36	+
14a	22 F.	20	2½	5	B	5	6	..	19	40	36	(+)
14b		25	2½	5	U	8	9	..	16	23	13	—
15a	34 F.	60	1	5	B	..	..	..	..	..	..	(+)
15b		30	1	5	U	..	..	..	..	..	..	—
16a	37 F.	30	2	5	B	..	..	..	..	..	..	(+)
16b		45	2	5	U	..	..	..	..	..	..	—
17a	46 F.	35	1	5	B	..	..	..	..	..	..	+
17b		35	1	5	U	..	..	..	..	..	..	—

B = Bitemporal electrodes.
U = Unilateral electrodes.

+ = Aroused completely.
(+) = Coma terminated temporarily.
— = Remained in coma.

TABLE II.—*Distribution of Clinical Results in Relation to Current Level.*

Current.	Transcerebral stimulation.				Unilateral stimulation.		
	Complete response.	Partial response.	Remained in coma.		Complete response.	Partial response.	Remained in coma.
4 mA .	0	0	1*	.	0	0	0
3 mA .	2	2	3	.	1	2	2
2½ mA .	2	2	3	.	1	1	5
2 mA .	3	3	0	.	1	0	3
1½ mA .	0	1*	1	.	0	0	1
1 mA .	1	1	0	.	0	0	2
	—	—	—	.	—	—	—
Mean quantity mA (mins.) .	8	9	8	.	3	3	13
	11.25	11.67	16.25	.	12.50	14.17	10.77

* Stimulation maintained for ten minutes.

stimulation it has already been admitted that this is not a perfect form of control, since a proportion of the current must inevitably penetrate the cranium. This is one possible explanation for the three instances (16 per cent.) of complete response and the further three partial responses obtained in this series. However, it is clearly not possible to draw an accurate comparison between the test and the control experiments on the basis of the clinical responses alone, since this does not take into account differences in the depth of coma at the time of commencement of stimulation.

The effect of electrostimulation on the depth of coma was both rapid and transient and this is well shown by the following clinical observations: In a total of twenty-three positive results (complete and partial) the longest interval between the discontinuation of the current and the appearance of a purposive response was six minutes. On four occasions the patient responded verbally immediately after the current was switched off, and on the remaining eighteen occasions this interval varied between one and five minutes, the majority responding towards the latter end of this period. Furthermore, in every case of partial response the subject was showing signs of a deepening sopor within approximately ten minutes of the cessation of stimulation. These results are very similar to those reported to follow the intravenous injection of glutamic acid (Mayer-Gross and Walker, 1947; Weil-Malherbe, 1949) and of adrenaline (Weil-Malherbe, 1949).

Glycaemic Effects.

Table I shows that in every investigation except one (Case 1a) of the test series there was a substantial increase in the blood-sugar concentration after transcerebral stimulation. The smallest overall rise in these investigations was an increase of 8 mgm. per cent. above the mean initial level (Case 3b), while the greatest was 41 mgm. per cent. (Case 4a), the average rise for the whole series (including Case 1a) being 17.5 mgm. per cent., standard error 2.0. In the one exception reported in Case 1a this increase did not take place and the concentration remained unchanged. The probable explanation for this will be discussed later. The blood-sugar curves in the control series show a similar variability of response, the increase after unilateral stimulation ranging from virtually none in Cases 7c, 8c and 9d to the substantial rise of 26 mgm. per cent. above the mean initial level encountered in Case 4b, the average for this series being 9.4 mgm. per cent., standard error 1.6. A statistical test was therefore applied to the two series of values to determine the significance of these differences.

Now for every control investigation performed a test investigation had also been carried out on the same patient under identical conditions of stimulation and blood-sugar analysis. In order to take this pairing of values into account the few random investigations were omitted from the test of statistical significance. The analytical results then represent sixteen pairs of blood-sugar curves, in each pair of which both members were performed under these similar conditions. In three cases (9, 10, 11) two pairs of curves were contributed by each individual, while the other ten pairs were each contributed by a different individual. The test of significance was then based on the variance of the differences in the increases of blood-sugar concentration in each pair of results. The sixteen pairs of analytical results are reproduced in

TABLE III.—*Glycaemic Effects of Transcerebral and Unilateral Electrostimulation during Hypoglycaemia.*

Blood sugar (mgm. per cent.).					
Case.	Electrode position.				
		Mean before stimulation.	Maximum after stimulation.	Increase x_1 and x_2 .	Difference $x_1 - x_2$.
1b . . .	B . . .	14	38	24	10
1c . . .	U . . .	4	18	14	
2a . . .	B . . .	6	21	15	
2b . . .	U . . .	7	15	8	7
4a . . .	B . . .	11	52	41	
4b . . .	U . . .	19	45	26	
5a . . .	B . . .	6	25	19	6
5b . . .	U . . .	6	19	13	
6a . . .	B . . .	11	26	15	
6b . . .	U . . .	21	34	13	2
7b . . .	B . . .	7	18	11	
7c . . .	U . . .	6	8	2	
8b . . .	B . . .	5	24	19	17
8c . . .	U . . .	7	9	2	
9a . . .	B . . .	13	25	12	
9b . . .	U . . .	11	18	7	5
9c . . .	B . . .	9	18	9	
9d . . .	U . . .	7	8	1	
10a . . .	B . . .	2	24	22	15
10b . . .	U . . .	6	13	7	
10c . . .	B . . .	3	20	17	
10d . . .	U . . .	11	15	4	13
11a . . .	B . . .	19	31	12	
11b . . .	U . . .	19	26	7	
11c . . .	B . . .	12	33	21	9
11d . . .	U . . .	5	17	12	
12a . . .	B . . .	6	25	19	
12b . . .	U . . .	10	20	10	9
13a . . .	B . . .	13	32	19	
13b . . .	U . . .	28	39	11	
14a . . .	B . . .	6	40	34	20
14b . . .	U . . .	9	23	14	

B = Bitemporal electrodes. U = Unilateral electrodes.

Table III, which records only the mean initial values of the blood-sugar levels before stimulation and the highest concentration attained after it. From these figures the increases (x_1 and x_2) have been calculated and hence the differences of increase ($x_1 - x_2$) for each pair. The absence of minus signs in this last column shows immediately that in every pair transcerebral stimulation (x_1) resulted in a greater rise than unilateral stimulation (x_2), and by applying the test to these figures it is shown that these differences are highly significant ($t = 8.08$; $P < 0.01$). This implies that stimulation of pain receptors in the skin and subcutaneous tissues is not the only mechanism responsible for the blood-sugar rise following transcerebral stimulation, although it cannot be eliminated as a contributory cause. The greater effect of the transcerebral as opposed to the unilateral stimulus must be due to a direct central action of the current in the former case.

Correlation of Clinical with Glycaemic Effects.

Adding together for the moment all the positive clinical responses, complete and partial, we then have two broad groups of cases, viz., those that remained in coma and those that did not. By comparing these two groups on the basis of the highest blood-sugar values obtained on each occasion during or after stimulation by either method, the results may be presented as follows :

Highest value of blood sugar (mgm. per cent.).	Coma terminated. (Number of cases.)	Remained in coma. (Number of cases.)
17 and below . . .	0 . . .	8
18 to 29 inc. . . .	10 . . .	10
30 and above . . .	10 . . .	0

It is seen that (a) when the blood-sugar concentration rose above 18 mgm. per cent. termination of the coma resulted on twenty out of thirty occasions, and (b) on no occasion did the coma persist if the blood sugar rose to 30 mgm. per cent. or above. According to the criteria of coma which were adopted—and which have been defined in the description of the methods employed—this does not necessarily imply a return to full consciousness, and it has previously been remarked that many of these cases were still unable to drink and that a few were not even able to respond verbally. Therefore, to determine if any similar relationship existed between the blood-sugar level and the later stages of recovery, as evidenced by an ability to drink, the complete and the partial positive responses were now compared on the basis of the highest blood-sugar values obtained on each occasion. It was then found that there was no significant difference between the two series, but that the blood-sugar values were similarly distributed for both degrees of clinical response. This implies that the return of consciousness at the higher levels is a more individual process than the termination of the state of coma as defined here.

To demonstrate the rate of change of the blood-sugar concentration following electrostimulation the means of each of the vertical columns of blood-sugar values shown in Table I have been calculated for both the test and the control investigations separately. The results then represent the mean blood-sugar curves obtained in each group and these are shown in Table IV. This demonstrates:

TABLE IV.—*Mean Blood-sugar Concentrations in Test and Control Investigations.*

	Blood sugar (mgm. per cent.).				
	10 mins. before.	Immed. before.	Immed. after.	5 min. after.	10 min. after.
Transcerebral stimulation:					
Mean	9.95	10.41	22.10	28.21	18.93
Standard error	1.13	1.15	1.24	2.19	1.93
Unilateral stimulation:					
Mean	10.07	11.38	17.75	20.46	14.43
Standard error	1.72	1.82	2.98	2.63	2.52

(a) The rapidity of the increase in the blood-sugar concentration. In both groups the rate of rise was at a maximum during or immediately after the passage of the current.

(b) The transience of the blood-sugar rise, which attained its peak about five minutes after the end of the stimulation and then declined rapidly in the ensuing five minutes.

(c) The magnitude of the rise. Transcerebral stimulation approximately trebled the blood-sugar concentration and unilateral stimulation doubled it.

These changes, therefore, appear to parallel closely the clinical course of events as already described, viz., the abrupt termination of the coma within six minutes after switching off the current, the brief period of consciousness or sopor, and finally, if glucose is not administered, the rapid return to coma ten to fifteen minutes after the end of the stimulation.

DISCUSSION.

The results have shown that transcerebral electrostimulation during hypoglycæmic coma causes a rapid and transient rise of the blood-sugar level, and that this is closely correlated with the clinical effect. These observations are in agreement with the facts reported by Riboli (1950), but conflict with the conclusions of Hoffman and Wunsch (1950), who found no such correlation. It has also been shown that the increase in the blood-sugar level is the result, predominantly at any rate, of a direct action of the current on the brain centres, since there is a highly significant difference when this central action is largely eliminated by unilateral application of the electrodes. These results are paralleled closely by those of Weil-Malherbe and Bone (1952), who reported that transcerebral stimulation by the author's method also causes a sharp rise in the concentration of the circulating catechol amines (combined adrenaline and noradrenaline), and that this is also correlated with the clinical response. The latter investigations were performed at this hospital using the technique of electrostimulation that is reported here, and on four occasions the two sets of

estimations were carried out simultaneously on the same patients (Cases 7b, 7c, 8b, 8c). The brisk increase of blood adrenaline was found by these investigators to reach its peak during the passage of the current and to fall immediately afterwards. It therefore precedes by a few minutes the hyperglycaemic response reported here. Weil-Malherbe and Bone also observed that the five applications of unilateral stimulation investigated by them did not result in any change in the blood-adrenaline level. These five control tests are also included in Table I of this paper, the clinical results only being recorded in three cases (15b, 16b, 17b), while in the other two cases (7c, 8c) the blood-sugar values are also given. It is interesting to note that on the latter occasions there was also no change in the blood-sugar level, while on all five occasions the patient remained in coma. The intercorrelation between blood adrenaline, blood sugar and clinical effect in response to electrostimulation is therefore good.

So far there is no reason to doubt that the glycaemic response is adrenergic in origin; nor is there any necessity to postulate the existence of a secondary mechanism, other than glycaemic, to account for the clinical effects. If this exists it must manifest itself in a quantitative, not a qualitative, discrepancy. It has been seen that in the present investigations a blood-sugar concentration of 18 mgm. per cent. was the absolute base line and 30 mgm. per cent. the maximal base line for the termination of coma. No case aroused below the former level, but 100 per cent. of positive responses occurred above the latter, but here the evidence is less conclusive, for the interpretation depends entirely upon appreciation of the level at which termination of the coma would occur in the absence of electrostimulation but with an identical rate of increase of the blood-sugar level, a point on which agreement has not yet been reached. On the one hand, Mayer-Gross and Walker (1945) reported experiments indicating that a blood-sugar concentration above 30 mgm. per cent. was necessary before sufficient glucose was available to the cortical cells for the restoration of consciousness. Accordingly, when after intravenous injection of glutamic acid consciousness was restored below 30 mgm. per cent. of blood sugar, a complementary mechanism was postulated by them (Mayer-Gross and Walker, 1947). On the other hand, Weil-Malherbe (1949), reporting similar results, concluded and has since confirmed (Weil-Malherbe and Bone, 1952) that the mechanism is adrenergic. He was also able by intravenous injection of adrenaline to duplicate in every respect the clinical and glycaemic effects of glutamic acid. Since electrostimulation has similar effects to glutamic acid and has also been shown to mobilize an adrenergic mechanism, the same conclusions are applicable.

The conclusion of Weil-Malherbe that an adrenergic mechanism is responsible for the decreased depth of coma following injection of glutamic acid is regarded by Hoffman and Wunsch (1950) as supporting "the relative unimportance of the blood-sugar level" which they found after electrostimulation. It is probable, as Weil-Malherbe (1949) in fact pointed out, that the adrenaline, when liberated, may also operate through auxiliary mechanisms which enhance the effect of the blood-sugar rise, but it was not suggested that the latter was unimportant, and it is improbable that the two can be dissociated. It is difficult, therefore, to understand how electrostimulation could terminate hypoglycaemic coma without producing a significant increase in the blood-sugar concentration, since the absence of such a rise is indicative that the current did in fact not penetrate the cranium. It may also be mentioned *en passant* that the absence of any significant rise in the blood-sugar curves of two patients who received pentothal and electrostimulation only, which Hoffman and Wunsch (1950) record as controls, is not surprising, since Piette (1950) has shown that previous administration of pentothal prevents the hyperglycaemic response which otherwise occurs following E.C.T.

Riboli (1948) was forced to postulate the existence of a complementary mechanism in order to explain his clinical successes in certain cases of prolonged coma. These had previously failed to arouse despite intravenous administration of glucose to the point of hyperglycaemia and injection of adrenaline, strychnine and vitamin B₁, but they returned rapidly to a state of consciousness following a short period (3-10 minutes) of electrostimulation. The writer can neither confirm nor deny this, since his experience is limited to only one such case. The patient in question failed to arouse completely after her tube-feed, but remained in a state of light coma. She received an intravenous injection of glucose and injections of vitamin B complex and of adrenaline, but without effect. Fifteen minutes later her blood-sugar concentration was estimated and was found to be 324 mgm. per cent. Electrostimulation

was then commenced, two-and-a-half hours after the onset of coma, and was maintained at an intensity ranging from 2 to 4 mA for a total period of nine minutes during the ensuing twenty minutes (2 + 2 + 5 minutes), but this also failed to rouse the patient. Half-an-hour later she received a further intravenous injection of glucose, after which she slowly returned to consciousness, but she remained confused for the rest of the day. This one case, therefore, does not confirm the findings of Riboli (1948, 1950) on similar occasions; others, however, may do so and no opinion on this point can be expressed at present.

One final point demanding explanation is the exceptional result reported in Case 1a of Table I. This was the only occasion on which transcerebral stimulation failed to cause an appreciable rise in the blood-sugar level, and the concentration on this occasion remained unchanged. This raises an issue which concerns every form of electrical stimulation of the brain through the intact coverings, and particularly to patients during insulin coma, namely that the amount of current actually flowing through the brain is always an unknown quantity, since the majority of the applied current passes through the low-resistance extracranial shunt network composed of the skin and subcutaneous tissues. This by-pass has been variously measured in animals and cadavers and estimated in man at between 85 and 99 per cent. of the total applied current (Fleming *et al.*, 1939; Golla *et al.*, 1940; Smitt and Wegener, 1944; Bollea and Manfredi, 1947; Hayes, 1950). With the degree of sweating which occurs in hypoglycaemic coma this by-pass may become an even greater and more variable quantity by the further addition of an extracutaneous conductor. This appears to be the only probable explanation for the results obtained in Case 1a, and confirmation might have been obtained by measurement of the interelectrode impedance. This, however, was not recorded and the matter must remain in doubt. In subsequent investigations the patient's head was first well towelled and similar results did not occur.

SUMMARY.

1. Cerebral electrostimulation of subconvulsive intensity has been applied to patients during hypoglycaemic coma. The current employed was composed of brief, unidirectional "square waves" and is described in detail.
2. Transcerebral stimulation frequently roused the patient from coma, but the final outcome still depended upon the administration of glucose.
3. Transcerebral stimulation caused a rapid and transient rise of the blood-sugar level, which was correlated with the clinical response in time and intensity.
4. This increase in the blood-sugar concentration is largely attributable to a direct action of the current on the brain centres, since it was significantly lower when the central passage of the current was reduced by unilateral application of the electrodes.
5. The results obtained are similar to those which have been reported to follow the injection of glutamic acid and of adrenaline during hypoglycaemic coma.
6. One case of "irreversible" coma was treated by electrostimulation in the presence of hyperglycaemia and was not roused by the current.
7. The opinion is expressed that the clinical effects of the electrostimulation may be attributed primarily to the changes in the blood-sugar concentration.
8. No opinion can be expressed at present concerning the value of this procedure in cases of "irreversible" coma with hyperglycaemia and further material in this field is awaited.

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A SPECIAL MENTAL HOSPITAL UNIT FOR THE TREATMENT OF PSYCHOSIS AND NEUROSIS IN JUVENILES.

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SINCE the treatment of juveniles as in-patients in a special unit is somewhat unusual in mental hospital practice, a brief introduction may not be out of place. These units might be considered as another development in a trend which has been progressing for the past 25 years. Until 1930 certification of all admissions to mental hospitals and a mainly custodial régime ensured the majority of patients being largely the end-results of psychiatric illness. Since 1930 the steadily increasing use of the voluntary system has brought many patients to hospital at a stage when their illness can be favourably influenced by modern therapeutic methods. An associated development was the increased provision of wards or units separate from the chronically disturbed cases, or even, as at this hospital, a complete villa system of detached and semi-detached wards for mainly voluntary adult patients.

In case-histories it is often clear that the real beginnings of illness lay in late childhood or adolescence. Unfortunately patients of this age are not suitably nursed with adults, and until recently there has been no appropriate in-patient accommodation for their investigation and treatment. Equally their disposal was difficult and often unsuitable. Some 4 to 15 per cent. of cases, as estimated by Penrose (1949) and Bergman *et al.* (1951) respectively, went to mental deficiency hospitals, while others were sent to approved schools and various homes. Many were kept in their own homes until breakdown became so acute and obvious that they had to be admitted to the mental hospital as the occasional "teen-ager" amongst a host of adults. Others were simply retained at home until old enough to go to such hospitals. For England and Wales such admissions of juveniles total some three thousand a year.

For these reasons separate units for male and female psychotic and neurotic juveniles were started early in 1949 at this hospital, where these types could associate with their own age-group, having their own therapeutic and social programme, uninfluenced by close contact with adult patients.

In the juvenile period there is psychiatric breakdown to a degree which from medical and social standpoints is as much a problem as such illness in later life. There are some who have stated that all children's and juvenile psychoses should be treated at home. Experience with these patients has shown that, however desirable this may be in theory, it is no more practical or safe for some types of juveniles than for adults. The truth of this view might have been inferred in any case from the frequency with which such cases have found their way for years into all kinds of makeshift in-patient accommodation, because home for one reason and another proved impossible or practically non-existent.

The St. Ebba's Hospital juvenile unit has 25 male and 25 female beds, and since the general setting of the unit, staffing and material facilities agree in principle with those described by Warren (1952) no further detail will be given.

Classification.

By working on this "link" period of adolescence it should be possible to understand better the disorders cloaked by such unsatisfactory terms as "maladjusted" and "prepsychotic," and to discover what they may represent in psychiatric disorders of later life. For example, some children who up to twelve years have been problems by reason of excessive timidity and shyness, change with onset of puberty to aggressive conduct, and then as they near adulthood show schizoid or schizophrenic illness. Incompleteness of development and maturation of the juvenile nervous system obviously limits the patterns of responses which these patients can show. As will be seen shortly, some adult illness appears to be almost unrepresented in childhood or early adolescence. Whatever the situation in those

under twelve years, experience of the over twelves shows that "maladjusted" cases referred to this unit after investigation usually qualify for schizophrenic, neurotic and psychopathic groups, and less often for the organic. The majority of those patients admitted as prepsychotic do not turn out to be psychotic, but if they do the diagnosis is usually schizophrenia.

Though these cases were sent for in-patient care because of the severity of their problems, it is some indication of the prevailing diagnostic uncertainty that only half had been placed in any of the main clinical groups, though nearly all had been referred by psychiatric specialists. Where diagnosis had been attempted it stood the test of in-patient observation and full investigation in two-thirds of all cases, but schizophrenia tended to be over-diagnosed at the expense of neurotic, psychopathic and epileptic states. In females particularly, patients were referred as schizophrenics who subsequently proved to be cases of hysteria. In view of the need for early treatment, it is satisfactory to find that so damaging a disease as schizophrenia was not often missed.

The most frequently occurring types in *hospital in-patient* practice are schizophrenia, neuroses and psychopathic personalities in practically equal numbers. The next in frequency are the epileptics, various organic states, post-encephalitic, post-traumatic, etc. Outstandingly low were the numbers of manic-depressives. Only one boy of fifteen years showed anything like a cyclothymic picture clinically, and one other a manic reaction. Both were discharged in a very satisfactory if not completely recovered state. There were but twelve patients who could properly be regarded as depressed to a psychotic degree. Three had made definite suicidal attempts. These depressions were mainly of "reactive" type (i.e., chiefly in response to stress), and sometimes occurred as episodes in psychopathic personalities. Most were short in duration, and only one was suitable for E.C.T. as described in the section on treatment. Paranoid and delusional symptoms were seen as transitory features of schizophrenic and psychopathic states rather than in systematized form. Sustained catatonic types of schizophrenia were unusual, but occurred in episodes.

Neurotic conditions were common, and in males the anxiety state predominated in the juvenile pattern of tension, tics, activity and behaviour disorder. Obsessional neurotics were rarely encountered, but obsessional ritualistic compulsive behaviour in schizophrenics was quite frequent, and seemed to represent a defence of a sort against further schizophrenic development. The adult anxiety type with psychosomatic symptoms and phobias was much less frequent. By contrast hysterical neurosis prevailed most often in the females, usually with recognizable hysterical personality features, conduct disorder and conversion of conflict into physical symptoms.

Psychopathic personalities constituted just under one-third of all admissions, including those with neurotic and psychotic complications. Since these patients may simulate other disorders, at least for a time, some had to be admitted for investigation. The grossest psychopaths appear where heredity and environment have conspired jointly to produce deprivation or arrest of moral and emotional development, a chronic emotional malnutrition as it were over years, which as experience shows can only be corrected by years of training and the assistance of a delayed maturation of the central nervous system. As a group they are quite unsuitable to be mixed with neurotic and psychotic types because they tend to gang up for aggressive purposes, to bully others and interfere with them. They need more supervision and staff than any other type. A few can be termed "reactive psychopaths," and have been disturbed by some precipitating trauma at home or elsewhere. These tend to settle down under the security of a hospital régime. In the others it is more usual to find that they are relatively quiet until they have taken the measure of the situation or become a prey once more to their innate restless aggression.

Approximately a tenth of all cases were found to have an epileptic constitution, often not suspected previously, and in which neurotic, psychotic and psychopathic disorders had developed. Organic illness had led to psychiatric breakdown in 5 per cent. Trauma, infection of the meninges or of the substance of the brain, and tumour were the main causes. The post-encephalitic cases were all hyperkinetic in type, and it is of interest that in this group, besides symptoms characteristic of post-encephalitis, there were others which bore the personality traits of the parents.

It is evident from the foregoing that after 12 years of age one can apply much

of the classification used in adult psychiatry, provided allowance is made for the changes which adolescence imposes on the clinical picture.

The foregoing remarks on classification indicate the types of case admitted to the juvenile unit between 12 and 17 years of age. Many patients have to be admitted for investigation in the first instance, since in the early stages of illness the only obvious feature may be some form of behaviour disorder, which in the juvenile period may prove to be the first phase of many forms of juvenile breakdown from schizophrenia to cerebral tumour.

Aetiology.

The approach to psychiatric disorder in the juvenile or adolescent period is based on the fact that it is essentially a phase of development and change. This constitutes a third factor as it were, a joint product of the fundamental factors of genetics and environment, all requiring consideration when responsibility for cause of breakdown is assessed. All cases need careful survey, both physically and mentally, for abnormal developmental trends. As with adults, breakdown is generally the result of a combination of factors, both predisposing and precipitating. Arrest, precocity and unevenness in development may each be concerned aetio-logically. Examples of such causal factors in the physical sphere are endocrine abnormalities, e.g., hypothyroidism, infection by infantile paralysis or post-encephalitis, and many forms of intellectual defect or precocity. In the mainly psychological direction one finds the insecurities, anxieties and hostilities of the maladjusted family, and at times psychological reactions to puberty. Since deprivation is strongly associated with development, it is unfortunate that the so-called deprived child or juvenile should be almost exclusively regarded as "emotionally" deprived or delinquent. The patients of this unit and elsewhere are deprived in various fields, not only emotional, but intellectual, hereditary, social, material, endocrine and others. Equally an excess of growth, intellectual and emotional development may be productive of breakdown. For instance, the role of the emotions in development is illustrated in the investigations of Widdowson (1951).

In a group of children of from 4 to 14 years, he has shown that anxiety stimulated by unsuitable personal supervision may retard physical growth in spite of adequate food, compared with controls on the same food but suitable care. In another way Bowlby (1947) in his study of juvenile thieves has demonstrated that deprivation of what might be called adequate emotional nutrition in early life can produce a type of boy lacking all ordinary affection. The E.E.G. may reveal maturation defect or unsuspected epileptic tendencies, and the psychologist often provides valuable data on intellectual capacities, or on schizophrenic, organic or other personality trends. Even with such assistance it is still difficult to discuss causation realistically, and to know why one youngster breaks down and another does not, though both are subjected to similar stresses in similar situations.

Treatment.

In many this begins on entry to the unit, since interpersonal and other stresses are so severe at times that removal of the youngster to an ordered and secure hospital atmosphere of itself effects much improvement. In a few a chance to stabilize the situation is all they need, but in most this initial gain needs further therapeutic support after investigation of patient and family.

Though separation from the home environment often has distinct advantages at first, sooner or later effort has to be made to adjust the patient to home and *vice versa*. In this phase trial periods at home are needed, and at times the parents or their substitutes may need as much interviewing as the patient. Parent and patient may require to be seen together, often a most illuminating event. In some cases with distant homes the absence of the necessary contact with relatives has been a considerable handicap.

The juvenile unit has its own version of the child guidance play therapy. If the unit is to avoid becoming a confused, disgruntled collection of youngsters acting out various morbid tendencies on each other, it is necessary to have a programme of suitably blended activities, which will provide therapeutically for their needs in social, educational and recreational fields. From the psychiatric point of view these activities not only form a series of test situations, the patient's response to which can be diagnostically useful, but are a means of achieving improved contact

and rapport. Education is supervised by two qualified teachers in small groups in school subjects daily, rather than in large classes. Art, play reading and dress-making tuition are given weekly under the Surrey Education Authority tutors. Occupational therapy is mainly through carpentry, various handicrafts, gardening and tailoring. Physical training, games indoor and outdoor, documentary and ordinary films, stamp collecting, excursions to local events, etc., all play a useful part in satisfying various needs. The foregoing yield information of diagnostic and therapeutic value, and are the counterpart, to some extent, of the play therapy situation in the child. While all these activities have their place, the most important single factor in daily affairs is the sympathetic management of nursing staff, who have to make suitable response not only to many tokens of affection, but to occasional impulsive attacks.

Psychotherapy.

Neurotic and depressed juveniles have responded well as a general rule to psychotherapeutic approaches on a relatively simple plane. Some are talkative enough from the start; others at first show various degrees of inhibition, resistance and sullenness, characteristic of the reticence of this age-period where personal topics are concerned. As Warren (1952) has said, it may be months before enough confidence is gained. By using intravenous or oral methedrine or sodium amytal much progress could be made in from one to four weeks, sometimes using a group of such assisted interviews in a period of several days. At times juveniles refuse to discuss difficulties which might appear relatively ordinary to an adult without the aid of this rather special procedure. For example, it was a long time before one youngster showed that part of his refractory conduct derived from his anger at the lack of letters from home.

Caution is necessary to avoid arousing too severe a disturbance in adolescents who, on account of their emotional immaturity, are more likely to develop states of excitement. Those psychiatrists who practised abreactive techniques in the last war will remember how it was found necessary to keep the patient awake to stabilize the progress made under sodium amytal or ether, and to prevent subsequent forgetting of significant material. With juveniles this danger is less, and quite often after methedrine it is advisable to give sodium amytal or other quick-acting sedative to control excessive emotional reaction. Full psycho-analysis is not possible with the present turnover of patients, and in any case would only be suitable for a few.

Physical Methods.

In this juvenile period some methods of established position in the treatment of adults have been found less useful, while others having been tried and found wanting in older patients, are showing promise when applied to juveniles. Physical methods in frequent use are insulin comas, prolonged sleep, and endocrine treatment. Perry and Levy (1950) stress the malignant course of adolescent and pubertal insanity in 273 cases in an American State Hospital, and show that only one in ten of those admitted before eighteen years have a chance of avoiding a lifetime in hospital at a cost of 30,000 dollars to the community. They contrast the poor results of "shock" treatment in the juvenile psychoses with the results in the adults.

Insulin Comas.

Levy and Southcombe (1951) noted only 6 out of 41 insulin-treated juvenile schizophrenias as making satisfactory adjustment out of hospital. By the same methods the authors obtained more than double the number of good results in their adult schizophrenics. In our own group of 48 insulin coma-treated schizophrenics 7 were considered recovered, 24 improved and 17 were unchanged. In all, 31 of this group have been discharged. These results are less satisfactory than in adults, but it is doubtful if valid comparison can be made between adult and juvenile. Furthermore, any series of results can only be assessed in proportion to the number of cases which can be regarded as acute schizophrenic episodes, who often do well, as opposed to those with long-standing failure to adapt to ordinary stresses from their earliest years. The average coma dose was 210 units in males and 220 units in females, i.e., similar to adults. Technical difficulties were the greater liability to fits in the hypoglycaemic period, small veins for intravenous and small stomach

capacities for nasal interruptions, and risk of interference with hypoglycaemia by surreptitious sweet-eating.

Prolonged Sleep.

In adults there has been a tendency to use E.C.T. rather than sleep treatment in various acute states of excitement and confusion, whether depressive, schizophrenic or neurotic in origin, since the effect is more rapid, the technique more simple and no additional toxicity is involved. On the whole in juveniles the reverse obtains, the response to E.C.T., if any, is often temporary, and sleep treatment has been much more effective, possibly with less risk of damage to the immature nervous system. It has also proved more useful as a means of improved rapport and abreaction. For producing sleep sodium amytal gr. vi to ix four-hourly, supported as necessary by paraldehyde, *drm. ii*, has been tolerated well by all cases, although these are usually adult doses.

E.C.T.

In view of the small incidence of psychotic depression noted in the section on classification, it will be evident that the scope and value of this method in juveniles, as compared with adults, is greatly reduced. Only 33 patients were treated, including 30 schizophrenias, 2 aggressive psychopathic personalities and 1 suicidal psychotic depression.

There has been much controversy over the possible traumatic effects of E.C.T. on adult brains, and though the sensorial, E.E.G. dysrhythmias and other abnormalities are generally temporary, it was considered that, until some proof to the contrary was produced, much caution was needed in using it on those whose nervous systems were still immature and unstable. This seemed justified when it was found that states of excitement and overactivity of "hypomaniac" quality had resulted temporarily in 5 out of the 30 schizophrenias, all of whom were particularly immature and unstable. The complication occurred after but 3 E.C.T. in two cases and after 5, 6 and 8 in the remainder. In 8 schizophrenias whose mood was strongly if abnormally maintained there was a good response apparently leading to discharge. In the remaining 18 patients 5 had acute symptoms temporarily alleviated. In some of these last cases E.C.T. was given during insulin sopor, where response to insulin comas had been slow. The rest showed no change of note. As regards the three other types treated, the psychopathic personality cases were not benefited, but the patient with psychotic depression reacted well, only to relapse owing to persistence of strong personal conflicts which hours of patient psychotherapy had failed to relieve in or out of hospital.

Experience with the juveniles has done nothing to alter the view that while convulsion therapy is almost specific for the psychotic depressions in the maturity of late middle age, treatment of depression in the juvenile period is usually a matter of psychotherapy, preceded at times by prolonged sleep and supplemented by relaxing or abreactive techniques. In juvenile schizophrenia rather less than a third showed any lasting gain with E.C.T., a few more were much improved in acute symptoms at least for a time, and the rest little changed. So far as could be ascertained there was no complaint of memory defect in this small series.

Leucotomy.

If at this age E.C.T. was considered with some reserve, more caution was used with leucotomy. Since the operation is so unusual in the very young, some information on the three cases given the operation may be of interest.

Case M— had a standard bilateral operation at another hospital in October, 1948. He had shown peculiar behaviour, little social contact with other children and alleged backwardness from six years of age. By twelve years he was restless, had many mannerisms and lived in a world of fantasy. Eventually he was hallucinated visually and auditorily and attacked staff. His father never liked him and finally left the home. His mother was over-indulgent but could not support him, and he lived several years in hostels. Psychological tests indicated superior intelligence. Since operation he has lost his hallucinations, is more settled and has few mannerisms. His emotional response is inadequate and he still tends to get grandiose ideas about his future, quite unrelated to practical possibilities. He showed homosexual trends for a time, but is now at 15 years becoming definitely heterosexual. He has improved after operation, but still needs care.

Case B—, 17 y , a schizophrenic patient of foreign extraction, had a standard bilateral leucotomy November, 1950. He comes of unstable and separated parents. After three years of unsettled but not grossly disturbed behaviour he became very bizarre in attitude, noisy, restless and impulsive. After operation he improved as regards acute symptoms but is still detached, has grandiose ideas of being a "superman" and on the whole has not kept his gains, though better than before operation.

Case G—, 15 years, appeared normal till two years and then mental development appeared slowed, and at six years he began to lose his speech and has since been mute. He was very excitable and tense. He was certified as mentally defective, though it was clear that he understood most of what was said to him and obeyed simple commands. Under sodium amytal he showed much affection to those near him. After operation, standard bilateral leucotomy, November, 1951, he has been more settled, less tense, but so far has only said an occasional word, though usually quite aptly.

Case W—, admitted at fifteen years of age suffering from schizophrenia, showed destructive and violent behaviour for three years, and continued to deteriorate. He was transferred to another hospital at eighteen years, and four months after a bilateral standard leucotomy was reported to be quiet, well-behaved on the whole and clean in his habits.

All four cases had trial with many other treatments before leucotomy.

There are indications that thyroid extract and oestrogens, so often tried with disappointing results in adults in the past, have value for selected juveniles, a subject which will be dealt with in another communication. Treatment of inadequate psychopathic, anxious and schizoid personalities by dehydroisoandrosterone has been outlined elsewhere (1952).

Disposal.

70.8 per cent. were discharged home, 12 per cent. to hostels, various types of homes and residential schools, 10 per cent. to other hospitals and 7 per cent. absconded. When disposal is examined according to the chief diagnostic categories there was a marked difference between the three largest groups of neurotic, schizophrenic and psychopathic cases. Only 25 per cent. of the psychopaths could be discharged home, as opposed to 84.5 per cent. of neurotic and 85.5 per cent. of schizophrenic patients. This is not a reflection of any particular disposal policy amongst groups, except that home was considered as first disposal wherever possible. In general it can be said that where constitutional factors were prominent, as in psychopathy, epilepsy, organics and defectives, there was a greater likelihood of institutional care being necessary.

Results on Discharge.

	Recovered.	Improved.	No change.	Total.
Schizophrenias . . .	12	23	11	46
Psychopathic personalities . .	1	40	28	69
Neuroses	10	33	4	47
Organic states	1	7	4	12
Epilepsies	1	18	4	23
Affective psychoses . .	6	7	1	14
Mental defect	0	4	2	6
	31	132	54	217

So far as possible cases of doubtful diagnosis have been omitted. Because of the poor prognosis generally attached to juvenile schizophrenia the above results are of interest, and to some extent can be accounted for by the acute cases who, though floridly schizophrenic, were on the whole prognostically favourable. In reviewing all the cases of schizophrenia admitted to the juvenile unit, whether subsequently discharged or not, under 30 per cent. were considered to be of an essentially chronic type. In my view, the full use of physical methods of treatment also contributed to the better outcome in many cases. The results and the disposal of the psychopathic personality group emphasize that for the majority of these cases investigation rather than treatment is the chief reason for considering hospital care. Follow-up studies are in progress.

I would like to express my grateful thanks to Drs. G. H. Chamberlain and A. M. Gregory for their assistance with the clinical work of the juvenile unit, and also to Miss B. S. McFie, Psychiatric Social Worker to the unit.

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HUMAN BEHAVIOUR REACTIONS TO ORGANIC CEREBRAL DISEASE.

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DIFFICULTY occurs at times in the diagnostic differentiation between the manifestations of organic cerebral disease and those of hysteria, particularly in patients who suffer from symptoms which are largely subjective in nature, and which are not accompanied by physical signs. An attempt is made in this paper to discuss behaviour reactions which are characteristic of organic cerebral disease, and which, if present, exclude the possibility of the disease being "hysterical" in nature.

GENERAL OBSERVATIONS.

In his book, *The Organism* (1939), Goldstein has described at length the behaviour of individuals affected by organic cerebral disease. This behaviour is aimed at preserving integrity in body and mind, and continuing as far as possible to live a normal life as the individual has previously known it. Goldstein demonstrates that a human organism attempts to preserve itself as an intact "whole" even when attacked by organic disease, to which it reacts by specific behaviour. It is suggested here that these behaviour reactions, which will later be defined, are entirely characteristic of organic disease as distinct from the conditions which are called "hysteria," and when they occur they are as significant of the presence of an organic lesion as are the generally accepted physical signs. The hysteric, in marked contrast to the organically diseased individual, does not demonstrate this behaviour. There is a tendency, or a willingness, on the part of the hysteric to dissociate, to disintegrate. He dissociates himself from his disease, or from the affected part of his body. The organically diseased patient attempts to maintain integrity by conscious or unconscious efforts. His behaviour is aimed at preserving normal functions even when he has no insight into his condition. A human individual develops to adult life with the ability to appreciate or perceive a certain range of sensations, and to perform a certain range of specific movements. His world is constructed within the framework of these sensations and movements. When organic disease causes a disturbance in the appreciation of sensations or the performance of movements, he nevertheless makes efforts to adhere to the framework, and to relate even disorganized functions to the original pattern. The hysteric tends to regard his symptoms as outside himself, and makes little attempt to relate them to the framework.

Care should be taken to assess whether an individual who demonstrates behaviour which appears "hysterical" possesses a "hysterical personality" or not. An individual with a "hysterical personality"—that is, one who is always liable to react to stress with hysterical symptoms—may appear grossly hysterical under the impact of an organic lesion, making diagnosis extremely difficult. An example of this is the patient J. K— (Dr. Critchley's case, *Nat. Hosp. No. 27743*), who suffered from hypertension with recurrent cerebral thromboses. On one occasion a thrombosis occurred in the right posterior cerebral artery. The patient complained of total blindness. His vision, however, improved considerably during the next few days, and on examination he was found to be suffering from a left homonymous hemianopia. It is possible that complete blindness was present during the first few days on account of the phenomenon known as diaschisis. The patient's behaviour was, however, so theatrical that hysteria seemed the most likely diagnosis. He peered cautiously around him, blinking his eyelids furiously, and spoke in quavering, high-pitched tones. He made curious gestures with his hands. This mime disappeared as his condition improved. Even while it was present he demonstrated behaviour characteristic of organic cerebral disease. This behaviour will now be described.

I. *Mood.*

The patient's mood, or affect, depends upon various factors—his desire to appear normal to others, his own reaction to his disability, his desire to remain normal

within himself, and his previous personality. If he has no insight into his condition he may insist that nothing at all is wrong with him, and attempt to continue to lead the life which he has previously known. Even when insight is preserved, he may appear casual, making light of his symptoms, unwilling to face the fact that his mind and body have become disordered. He may therefore present the superficial semblance of indifference which is classically associated with hysteria. Questioning and examination will generally reveal, however, an underlying anxiety or depression. The patient may be reluctant to admit his disabilities, in distinct contrast to the hysteric who is glad to make the most of his, which serve a useful purpose in his life. Organic disease may cause symptoms so abnormal as to be confusing, alarming, or even terrifying to the patient. He is afraid to discuss them, partly because he feels that to confess them is to admit disease, and partly because he fears that he would be considered out of his mind if he described them. The hysteric, on the other hand, is at ease with the most strange symptoms.

Organic disease may sometimes give rise to intense melancholia whether the patient has insight into his condition or not. Patients with disabling organic disease may of course preserve insight, in which case the depression may be called reactive. Others, however, in whom insight is lacking, may suffer from severe depression which seems to be determined by the disturbing effects of the lesion on cerebral function. Two depressed patients suffering from the effects of cerebral tumours were recently admitted to the National Hospital under the care of Dr. Critchley. The first, H. S— (Nat. Hosp. No. 34,673), had a glioma in the right parietal region. The second, A. H— (Nat. Hosp. No. 36,459), had a large glioma in the left fronto-parietal region of the brain. The patients were aged 55 and 56 years respectively. Both patients had previously possessed cheerful, good-natured personalities. Neither had shown tendencies to obsessional behaviour, or symptoms of tension or anxiety. Neither of them had ever suffered from a previous attack of depression, nor was there a family history of any kind of mental illness. The first patient, H. S—, preserved partial insight into his condition, and as his illness grew worse his depression increased. The other patient, however, had little or no insight. Depression may therefore be regarded as one of the effects of organic cerebral disease. Organic disease may also cause a patient to appear fatuous, as may occur with lesions which affect the frontal cortex, or he may seem excessively genial, or aggressive, or over-obliging or over-talkative. On the other hand, the disease may sometimes cause the patient to be completely silent and withdrawn. These moods are partly the result of the patient's desire to conceal his disabilities and seem normal. The pretence of normality continues until he is asked to perform some task which would expose his disability. Even if he has no insight, when he senses this exposure, the mood of the patient changes. A perceptible tension develops. He becomes restless and uneasy. If he is finally forced by circumstances or by the doctor to become aware of, and admit, his disability, the "catastrophic reaction" is likely to result.

II. *The Catastrophic Reaction.*

This is a very sudden, overwhelming and extreme distress, generally accompanied by weeping and signs of intense despair. It is a highly characteristic feature of organic disease. It occurs, as has been stated above, when the patient is made acutely aware of his defects. The reaction of distress may last for several minutes and recur at frequent intervals. It is the very antithesis of hysterical indifference, or benign acceptance of disease. It is as a rule possible to perceive the increasing anxiety of the patient during examination, if the catastrophic reaction is impending, and it is often necessary to employ subtle tactics and reassurance in order to prevent the patient's emotional breakdown. The patient will go to great lengths to avoid the catastrophic reaction, and much of his behaviour is directed towards this end. He protects himself from it by—

- (a) Orderliness.
- (b) Trick movements and ingenious manoeuvres.
- (c) Avoiding situations which would expose his disability.
- (d) Using other senses to take the place of the affected ones.
- (e) Finding excuses and seemingly plausible false reasons for failures.

(a) *Orderliness*.—The patient will often go to great pains to develop a system of routine and order in his way of living, and he may keep his possessions scrupulously

tidy. This orderly manner of living makes it easier for him to maintain a normal existence, lessens the burden on his memory and permits him to perform the same limited functions day after day. In addition to this fact, there seems to be a compulsive, almost unconsciously determined desire for order in the patient with organic disease of the cerebral cortex. Carried to its limits, the process becomes a desire or need to perform simple, isolated functions, and to deal with only "one thing at a time." The patient is unable to cope with several matters at once. He is unable to cope with several sensations at once. He chooses the most powerful stimuli and neglects the others. He becomes confused and unhappy when multiple stimuli assail him. An example of this is provided by a patient, Mrs. I. B— (Dr. Critchley's case, Nat. Hosp. No. 38299). This patient suffered from a left homonymous hemianopia and spatial disorientation as the result of a lesion in the right cerebral cortex. She complained that everything appeared confused and "unpleasant." It was noticed that she constantly placed her hands over her face in such a way as to restrict her field of vision even further. This was, in fact, an attempt to eliminate as many visual stimuli as possible except those from single objects directly in front of her. When she was asked why she placed her hands in this position, she replied that to look at "many things at once" gave her a very unpleasant feeling and impression. She said that she hated to receive from her friends large bunches of flowers or quantities of fruits. She said they "upset her terribly, although she couldn't understand why." She had told her husband to bring her only one or two fruits at a time and two or three flowers. These small quantities were to be seen at her bedside. When she was shown a tray on which many small articles were jumbled, she looked at them and said she felt exceedingly "upset" by them—they gave her the same unpleasant impression. She asked if she was permitted to arrange them and promptly tidied them into little heaps—keys in one heap, square objects in another, long objects (such as a pencil, pen and nail file) in another, and so on. When she had finished she said she "felt much better about them," and she could bear to look at them. Previously, to look at them had required an effort. This passionate craving for orderliness could be seen in much of her behaviour, and her few possessions were kept fanatically tidy.

The inability to deal with more than one matter or perception at a time can be easily observed during the examination of organically diseased patients.

(b) *Trick movements and ingenious manoeuvres.*—If a disability is present which impairs the sensation and movement of a limb, the patient will find means to continue normal activities by means of trick movements, or complicated round-about actions of the healthy limbs. These manoeuvres are often comical or sad to watch, especially when the patient is not aware that he is being observed. They are very characteristic of organic disease. A patient will often practise in private some test at which he has failed during examination. He may find some way of circumventing his disability. For example, if a patient is spatially disorientated, he may learn to find his way about by placing brightly coloured or conspicuous objects in key positions about the home or ward. The patient, Mrs. B—, described above, always placed her bed-jacket carefully across the foot of her bed when she left it to go to the bathroom, so that she would recognize the bed on her return. As an additional safeguard she counted and memorized the number of beds on either side of hers along the ward, and could therefore calculate which was her own.

(c) *The avoidance of situations which would expose the disability.*—The patient will also protect himself from the "catastrophic reaction" by avoiding tasks which he is unable to accomplish on account of his disability. This avoidance may be motivated at a level below consciousness. For instance, a patient (F. D. P—, Nat. Hosp. No. 17289, Dr. Kremer's case) suffering from acquired auditory agnosia or inability to understand the meaning of sounds, although she could talk perfectly well, took great care never to ask a question during conversation. She always kept up a running stream of talk, thus preventing others from questioning her or making remarks incomprehensible to her. If forced to give a reply, she would say "Oh yes," rather absently, or make a vague murmur, and then immediately start off on a subject of her own, and she was thus able to conceal her defect. It was only after some time that strangers realized with astonishment that she understood not a single word of what was said to her. Mrs. B—, the patient mentioned above, who was spatially disorientated, refused point blank to make even the slightest attempt at drawing a map when asked to do so, and burst into tears "catastrophically" when the examiner insisted on her trying this task.

(d) *The use of other senses to take the place of the affected ones.*—A patient with defective vision may use touch to aid him with the perception of objects. The disability resulting from defective hearing may be lessened by the use of vision, as in lip-reading, and so on. An example of this is the behaviour of a patient (case R. R.—, Dr. Gooddy's case, Nat. Hosp. No. 34717) who suffered from a type of visual disorientation. All objects appeared to her to be very small and seemed to recede slowly into the distance. She was asked to judge the distance of certain objects in the room from her bed as she lay there. She said, "I know things can't be as far away as they seem because I've measured this room by walking up and down and across it, and it's only a small room." When she was asked to describe an object by looking at it she always stretched out her hand towards it, and if she was able to reach it, she would examine it carefully with her fingers before replying. This tactile aid to vision seemed almost compulsive, because her hand had to be forcibly restrained if she was to use vision alone during the test. As Goldstein has pointed out, "there is a tendency for the organism to maintain a performance capacity on the highest possible level, compared to its former capacity." This tendency is to be seen in *organically* diseased patients only. The hysteric does not wish to maintain a high performance capacity.

(e) *The excuses made for poor performance* are generally feeble and often naïve, although they seem sufficiently valid to the patient. For instance, if writing or drawing are impaired, the patient may say, "I haven't done any writing for a long time," or "I've never been able to draw, not even as a child." A patient has even been heard to excuse her poor memory by saying, "I've been lying in bed so long, I haven't had to use my memory. I'm out of practice." The genial, worried, "Ah, now you've got me—I never *could* do—such and such. You've found my weak spot all right"—(when the patient is asked to do as simple a task as, for example, the drawing of a daisy head) is so common and characteristic as almost to be diagnostic of organic disease by itself.

The behaviour described is aimed at protecting the patient from the catastrophic reaction. In addition, there are other factors which are typical of organic disease.

III. *Difficulty with the Description of Symptoms.*

If the symptoms of disease are very strange, the patient may be unable to understand what has afflicted him. Sensory symptoms may be so unlike normal sensations as to be indescribable. The patient with organic disease will seldom volunteer information that seems "crazy" to him. He will prefer to keep an uneasy secrecy. If he trusts the examiner, however, he may be persuaded to describe his symptoms, and will do so in a typically bewildered and hesitant manner, with many apologies and interjections of, "I know it sounds rather silly," or "I don't expect you'll be able to understand," or, "It's crazy, isn't it?," and so on. Fear is a common accompaniment of bizarre symptoms such as distortions of vision or other sensations. Hallucinations always give rise to alarm. In addition, the patient may be aware that "something is wrong," but he may be able to discuss his troubles in general terms only. It may require a careful and patient analysis of symptoms into their component parts before an exact description can be given. For example, to a patient suffering from spatial or visual disorientation the world may "seem a muddle." Examination may reveal that the cause of the "muddle" is loss of stereoscopic or binocular vision, or partial loss of vision due to scotomata, or movement of objects due to nystagmus, or visual perseveration, and so on. The most strange symptoms are likely to occur during the early stages of disintegration of function (and therefore before the appearance of physical signs which develop later), before total ablation of function has occurred. Hallucinations, for example, may be experienced as early symptoms, which disappear as the disease progresses. A hysterical patient will, as a rule, have no hesitation in describing his symptoms in detail. An organically diseased patient who has bizarre symptoms may unconsciously invent or superimpose other symptoms upon the real ones, in order to make them more readily understandable to himself. In other words, he attempts to relate them to the original "framework" of sensations and movements. If, for instance, a limb is affected by a sensory disturbance and become clumsy or "dyspraxic," the patient may say the limb is paralysed—that it is "weak," or "useless." In fact, there may be no loss of motor power, nor change in the tendon reflexes. Gooddy (1949) has pointed out that sensation and movement are inseparable. It is therefore

not surprising that a sensory defect will cause disorders of movement even though the motor component of a movement is unimpaired. This state of affairs may be seen in patients suffering from isolated disease of the thalamus, one example of which has been described by Head and Holmes (1912).

IV. *Desire for Reassurance.*

When the patient does admit to having a disability he demands reassurance, and hopes and believes he will be cured. This hopeful attitude may be easily seen from his efforts to help himself and his desire to succeed at all performances. He suffers from a great unwillingness to accept the disability. "It's nothing serious, is it, doctor?" "It'll pass, won't it?" he says.

V. *Variability of Performance.*

Another marked feature, highly characteristic of organic cerebral disease, is the variability of symptoms and signs and the variability of performance. This has been described by Goldstein (1939) and Critchley (1950). The patient's symptoms and subjective signs vary from moment to moment, or from day to day. Variability is in itself an indication of the organic nature of the lesion. A hysteric tends to preserve his disability in a clearly defined pattern. The organically diseased patient may, at one time, be able to perform a certain movement or test without hesitation, while at another he does not know how to begin it. Total ablation of function does, of course, occur in organic disease, but not unless the disease is gross or advanced. Hysterical patients tend to suffer from severe or absolute defects of function. In addition, sensory disturbance in organic cortical disease is "graded." There is seldom a distinct and easily defined boundary between normal and abnormal sensations, but a gradual change from one to the other.

VI.

Another feature of organic disease is that a single function or performance will never be affected in an isolated manner—as may be the case in hysteria. Invariably other performances are also affected, although perhaps to very slight degree. Defects of performance in other fields are always demonstrable. Certain aspects of behaviour and performance, however, may remain intact, while others are impaired. An example of this is the case J. A— (Dr. Williams's case), a girl of 8 years, who was thought to be a "bright child, suffering from a fairly specific word-blindness." On examination, apart from her great difficulties with reading and writing, it was found that her powers of calculation were defective, she was unable to tell the time correctly, she showed slight right-left disorientation, and a slight difficulty with voluntary movement (she was unable to tie a bow, or to knit). She was, however, a cheerful, energetic child, who talked normally, could help her mother in the house, and had many friends of her own age, who did not apparently regard her as abnormal in any way.

VII.

Finally, Goldstein has pointed out that the patient with organic cerebral disease is unable to cope with abstract situations, or prefers to deal with the "concrete." Goldstein's term for this is "categorical" behaviour. When this behaviour is seen in a person of previously normal or high intellectual capacity, it is essentially a feature of organic disease. For example, a patient who is asked to give a list of colours describes those which he can see in the ward around him, or if asked to give a list of animals, does a mental tour of the zoological gardens, naming cage after cage as he remembers them. The patient may have no hesitation in admitting this trick.

SPECIFIC DISTURBANCES OF FUNCTION OCCURRING IN ORGANIC CEREBRAL DISEASE.

(1) It is probably true to say that when a distortion in the perception of sensory stimuli belonging to a particular category occurs as a manifestation of organic disease, impaired appreciation of the particular stimuli is also present. For example, if a visual disorientation occurs, some degree of impairment of visual acuity in the field in which the disorientation is present can be demonstrated. Similarly, if tactile inattention is present in a part of the body, some impairment

of appreciation of touch should be demonstrable in the affected part. This impairment may, however, be exceedingly slight.

(2) *Incontinence*.—Hysterical patients are rarely, if ever, incontinent of urine or faeces during attacks resembling epilepsy, or at other times.

(3) *Homonymous hemianopic field defects*.—These are seldom hysterical in nature.

(4) *Visual hallucinations*.—When these are of ill-defined nature, and grey or dull in colour, they are rarely hysterical in origin.

(5) *Mirror-writing*.—It is generally believed that the performance of mirror-writing indicates hysteria. The cases of mirror-writing originally reported by Critchley (1928) describe mainly right-handed patients who wrote mirror-wise with their left hands—this representing a dissociation. Mirror-writing, when performed with the right hand in right-handed patients, is a form of "dyspraxia," possibly due to an inability to perform movements at will in specific directions. It is, perhaps, also sometimes associated with disorders of the vestibulo-ocular system. Of four patients admitted to the National Hospital demonstrating mirror-writing or mirror-performance of some kind, two suffered with vascular lesions of the left posterior cerebral artery, one had a tumour in the right parietal region of the brain, which extended deeply to involve the corpus callosum, and one had a pinealoma which was centrally situated.

Lesions which give rise to symptoms of a subjective nature may, of course, involve the visual pathways or visual cortex, the sensory pathways or sensory cortex, the vestibular system or vestibular connections, the "parietal cortex" in either hemisphere, the corpus callosum, or the temporal lobes. The disturbances which arise as a result of these lesions are largely qualitative in nature, or subjective, and often cannot be substantiated by objective information in the form of physical signs. The behaviour reactions described above will, nevertheless, confirm the presence of organic disease in the majority of cases.

SUMMARY.

In an attempt to distinguish organic cerebral disease from the conditions called "hysteria," it is suggested that patients suffering from organic cerebral lesions demonstrate specific behaviour reactions (some of which have been described by Goldstein), and that patients suffering from hysteria do not show these reactions. Organically diseased patients attempt to preserve the integrity of body and mind, and to maintain a normal existence. Hysterical patients tend to dissociate and to disintegrate. A patient with organic cerebral disease, if forced to become aware of his disability, is liable to suffer from a "catastrophic reaction." He tries to protect himself from this reaction by orderliness, trick movements and manoeuvres, the avoidance of situations which would expose his disability, the use of other senses to take the place of the affected ones, and the finding of excuses for his failure. Organically diseased patients may have difficulty with the description of unusual symptoms (in contrast to hysterical patients), they preserve an anxious attitude towards their disabilities, and require reassurance; they demonstrate great variability of signs, symptoms and performance. Finally, organic disease of the cortex diminishes a patient's power to deal with abstractions.

These behaviour reactions may help to confirm the presence of organic cerebral disease in those patients who suffer from symptoms which are subjective in nature and are not accompanied by physical signs.

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PICTORIAL ART, VIEWED FROM THE STANDPOINT OF MENTAL ORGANIZATION AS REVEALED BY THE EXCITATORY ABREACTION TECHNIQUES OF PSYCHIATRY.

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THE pictorial work of art bears witness, above all else, to the process of creation. Whatever it is that differentiates a work of art from mere skilled productivity—(and aesthetic theories rage about this issue)—it would appear that only in the case of the former is the spectator made conscious of that heightened scale of perception, at once purposive, integrated, and whole, which is the distinguishing feature of creative activity. And if we admit the principle of creativity in artistic expression, then we must seek in paintings something more than a reproduction of external appearance. The visible world indeed is the raw material of art, but it is moulded and fashioned by the artist according to his own purposes and, it is now suggested, by certain qualities of reminiscence. As a consequence of the relation which exists between his own emotional life and these qualities he creates in pictures a world of reality which has for him a compelling intensity—an irradiance in which he finds meaning and justification for his work. It is the embodiment of some new state of comprehension, bringing order, coherence and purpose to what otherwise would be formless and lacking in meaning. This world re-born, founded in experience, is invested with conviction and validity. The making of such an extra-sensory world is at the heart of creativity, for only so can the artist create the conditions for a communicable experience. A purely private world is mysterious and incommunicable, and does not provide the conditions in which schools of art can develop.

Yet on the whole it is true to say that an artist's work conforms to an "image-type" which is quite characteristic, so the mention of an artist's name is likely to evoke in our minds a configuration which is usually distinctive and well defined. It is unlikely that the artist consciously evolves for himself a view of reality and then proceeds to "express" it; it is more likely that, working freely with the materials at his command, he creates as his nature and impulse constrain him to do. The character of his image would appear, therefore, to have relevance to himself as a total experiencing individual: that is to say to his inner resolution of conflict, to the goals he deems worthy of attainment, and to his orientation of experience to the reality of the world around.

It is interesting, therefore, to inquire whether it is possible to correlate an artist's basic configurations as exhibited in his paintings with any known orientations of the self to reality. If we can detect some basic patterns in which the self can reach adjustment, and can relate these to the "image-types" revealed by the work of artists, we will have a means of classifying an artist's productions in terms of a basic adaptation to reality.

Such a possible basis of classification is provided by the study of ego-organization in relation to ether abreaction therapy reported by one of us (Palmer, 1951, 1952). The reactions of patients in different stages of ether anaesthetization reveal different orientations to the world of their objective experience. These orientations assume distinct and recognizable phases which become apparent under the control of the anaesthetist, who leads the patient into a recapitulative reminiscence of past events; The patient re-lives these events, but the extent to which he may be said to co-exist with this world of recollected experience may vary; sometimes he may be an onlooker, and may even be aware of observing himself participating in the events, or he may identify himself completely with the situation re-enacted. Or, again, he may never lose awareness of his immediate surroundings and of the objective operator-patient relationship.

At this point it is perhaps important to interpose a brief description of the technique of ether abreaction. If a person lies on a couch and is subjected to mild ether inhalations, he may utter very little of apparent interest and presently pass into a state of anaesthesia. There is, however, in the beginning in all cases an excitatory stage. During the war it was sometimes considered desirable to recover from the

soldier a buried memory of a traumatic battle episode. It was found possible to do this by exhorting the soldier to go over his battle experiences during this excitatory stage of ether anaesthesia. When so doing there was nearly always an abrupt change from a first stage, during which the patient gave an everyday account of events, to a second stage during which he seemed to relive the experience of the traumatic episode. This second stage nearly always concerned the theme of failure or death, or it might be injury as, for instance, threatened blindness or loss of a limb. During the use of this technique it was sometimes found that the patient would unaccountably switch on to a third type of reminiscence which invariably concerned events antecedent to those whose evocation concerned the primary aim of this technique. In this third stage the patient commonly described himself as a spectator looking down on a scene in which he "saw himself" as an actor. The drama comprised figures of less than ordinary size exhibiting high animation and vitalistically coloured in the manner of a pageant.

Finally there might emerge a fourth stage which was dream-like in quality, having the character of a caricature with a high content of symbolism and often related to events in very earliest childhood. The figures in this stage resemble the work of medieval stained glass and were once again life-size or larger. Many patients have been investigated, and the relative frequency with which these four stages are reproduced would appear to constitute the validity of their demarcation. They are reproducible scientific phenomena. Their striking resemblance to certain art forms is the theme of this article.

We believe that there are four basic stages of orientation to real experience, and that these bear definite relation to the "image-types" revealed by the configurations of artists, and see here a basis for an inductive investigation of their works. The assumptions made are that these four stages noted are real types of adaptation having universal validity, and that they represent effective stages in a person's basic self-orientation and self-awareness, and that the artist in his work will reveal his identification, in the main, with one particular stage. The four basic stages may now be described:

(1) First there is awareness of the world of common everyday experience, such as is revealed by photograph. It is the world of familiar objects revealed by light and shade, the world of our mechanical vision, unorganized and unrelated. It is but the immediate, instantaneous impression—instantaneous as is a photograph, and excludes those processes which occur in time, of searching, adaptation, and organization, which are necessary for the production of a work of art. It is nevertheless the "real" world of our work-a-day life—that world in which we are concerned to identify objects which correspond to a word-picture we have stored in mind and which we recognize by name. It is the world of recognition and not of perception, the world of "fact" and science, the world of the machine and of utility, in which the criterion of value is function, usefulness and physical relation. It is from this world that the artist makes his departure, perceiving over and above the mechanics of a visual situation a relatedness and significance which, from the viewpoint of the physical world of sensory experience may be useless, but which for him is the basis of its value.

(2) The next stage is consistent with a well-known type of artistic organization of this world of photographic impression, the artist imposing upon it some theme, perhaps romantic or even sentimental, so that it becomes organized in some definite manner. Many works of this kind have little or no artistic merit. They do not seek to create more than a representation of some easily recognized emotional situation, which has the effect of organizing the mechanically perceived world by stamping upon it an episode—dramatic, narrative, descriptive—which comes within the orbit of familiar experience to which the observer can respond, and so can find a source of communicable experience. In this category we may place the 19th century Academy story picture—the conversation pieces, the domestic interiors, the battle scenes. But here also we may place paintings of real artistic merit; the ballet dancers of Degas, the exotic scenes of Delacroix, the "themes" of light and shade popularized by the impressionists, and we should not forget Vermeer, whose pictures are typically—for example, the "Girl Reading a Letter" in the National Gallery—transcriptions of the world of direct perception, arranged so as to "express" some quiet domestic episode. Indeed, episodic naturalistic work has probably been a recurrent phenomenon throughout the ages. The later phases of Greek sculpture come within this category. It is doubtful whether "primitive" works owe their

naïvety to lack of technical skill ; at least there is evidence of a tradition of naturalism occurring alongside the more formal and expressive works of past ages. There is, then, a well-marked tendency to take over the deliverances of direct sense-perception, and make them the means of presenting some communicable experience—sometimes trivial, but sometimes more profound.

(3) In the next stage there is a striking change in the patient's perspective, so that what is seen is viewed from above—he is looking down on the scene—and this scene is mobile, vitalized, Lilliputian, and one in which the entities of a given space may seem concentrated in close juxta-position. Yellows and greens predominate, reds, blues and purples are uncommon. Not only is he spectator, but also he is an actor on the stage—it is "I" watching "Me." The affective tone is rich, lusty and exciting. It is a world of ballet and mime and certain movie sequences (e.g., *The Red Shoes*). It also partakes of the world of parable. Animals and men utter sentences pregnant with meaning and akin to the world of hallucination. It is a pantomime world in transformation and seen panorama. Landscapes and architecture fit in with the mood in the manner of an illuminated manuscript. It is a Gothic world of mystery play, pageant and fable. It is the world of many of our pleasurable dreams and one from which we do not seek awakening, and for which the interpretation either dawns on us or none the less satisfies. For it has meaning for the daemonic levels of our soul. There are many paintings which typify such a world in miniature. For instance, Brueghel has revealed a world peopled by small figures actively engaged in various tasks, seeming to have almost the restless activity of ants. Gainsborough's "Whitehall Steps" is a beautiful example of this technique. Such a world is also portrayed in certain paintings and reliefs of Egypt and Mesopotamia, where we see the activities of king and courtiers, the epitomized story of wars and events, presented on a reduced scale. The paintings and reliefs of India are famous for the vast panorama they present of multifarious activities, concentrated and teeming, so that before one proceeds to the elucidation of any details, one is first struck by the Lilliputian conception of the whole. Some modern artists present us with a world of factories and artisan dwellings crowded together on a miniature scale—a world adapted for the Lilliputian stature of modern industrial man.

(4) In the next stage the objective world is more diffuse and broken up, and organization comes through strongly coloured forms, often defined by outline. It is a world re-created through symbols. It is the world of the medieval stained glass artist. We have here, perhaps, a more primitive vision which imposes itself on the outward forms of nature. It is exhibited well in primitive and "expressive" art generally, for example in the early paintings and mosaics of the Byzantine period in which figures are not flesh-and-blood persons, but symbols of the mystery and essence of being. Gesture and costume are not naturalistic in intention ; faces are strongly outlined and deeply expressive. A contemporary painter whose work is strongly religious in character is Georges Rouault, and here similarly we may see a symbolic approach to the problem of human character ; but indeed it is a problem which runs through the whole history of art.

(5) A fifth stage may be discerned, in which the forms of nature are so entirely disintegrated and reduced to pattern that the reality of objects is no longer maintained. Here we may place certain types of abstractionist work—for example that of Jean Miro—where a reality is created, not by any relation to the objective world, but by pure relationships of colours and forms. These relationships may perhaps be capable of symbolizing certain types of emotional experience.

It is the nature of the case that the distinction between these stages must not be pressed too rigidly and, as is to be expected, a good deal of overlapping occurs. Yet it is possible to see here the gradual emergence of a more primitive vision, or inversely, from Stage 5 to Stage 1, to detect a gradual sophistication, an increasing intellectualization, of the visual process.

It is difficult to speak with any certainty of Stage 5 as it is manifested in the work of modern artists, because here the reduction of visual phenomena to pure colour and form is not a simple instinctive process, but is a deliberate simplification—a conscious intellectual procedure which has its roots often in elaborate and highly specialized theories of art. To this extent it is an aspect of pseudo-primitivism. Modern man least of all is likely to see nature as pure form ; he may detect formal relationships of colour and shape, but he is always aware that these are but intrinsic aspects of the entities which make up the real objects of the world around. Stage 5,

properly speaking, is the simplest and most primitive awareness of the world disclosed by vision. We may presume it to be the original state of awareness which is gradually added to by the growing child. It represents the direct sensation of colour and shape which is registered on the retina of the eye—unadulterated by any procedures of the knowing mind—and which the subject has not the knowledge or experience to reconstruct into objects of thought. Thus an object is seen simply as a coloured shape; the latter is not “attached” to the particular object. The importance of this direct primitive aspect of vision cannot be too strongly stressed. We tend to take too much for granted the sophisticated vision represented in Stage 1, and thereby lose the great value which attaches to the “innocent eye.” The first, the immediate impact of vision, is that of direct awareness of pattern; the orientation of this pattern in depth and in terms of specific objects is a product of experience. Once the habit of such orientation has been acquired it tends to blunt the perceptions so that the existence of the pattern is no longer recognized, with consequent loss of one most enduring characteristic of nature. Furthermore, with the loss of pattern goes the loss of a sense of relationship, and colours and shapes are no longer seen for what they are, but only for the use they can serve in supplying data to the process of world-construction. For this reason Stage 1 is virtually the reverse of Stage 5, because in the former case colours and shapes are simply not seen unless they can be recognized as the sense data of specific objects. The basic primitive vision of Stage 5 is therefore a valid form of experience, and is justifiably involved by modern artists in their search for the full implications of vision.

In the 4th Stage we have still a fundamentally primitive vision. It is the first transition of the pure undifferentiated pattern towards conceptual forms. A great deal of pure pattern remains, but it is now organized so as to express in visual terms some aspect of experience—yet achieved, not by an objective treatment of nature, but by an inter-weaving of what is known in experience into the basic structure of the pattern. In the result there is still a good deal of flatness, with areas of pure “decorative” colour, but there emerges an image at once strongly symbolic and deeply expressive. We may say that the unconscious is able to find in the pattern the means of organizing its own experience. All expression depends on means, and these means will determine the end achieved. A primitive means of expression does not limit the power of the thing expressed, but only qualifies what can be attempted in expression; and it often happens that the more primitive the means, the more primitive the image expressed. (Indeed, means of expression can become so elaborate that in the process technique becomes an end in itself and the reality of an expressive act is lost.) A primitive means both significance, and this occurs when an expressive act arises out of the first direct awareness of pattern. Thus, it may be supposed that the pattern performs the function of drawing out the thing expressed as well as accounting for its primitive character. Shakespeare has this to say of the imagination,

“Or in the night, imagining some fear,
How easy is a bush supposed a bear,”

and if it is the imagination which creates the “bear,” it is equally true that the affective context of the night-time supplies the necessary conditions in which this imaginative expression of fear can be made. In the same way it may not be fanciful to suppose that the perception of a fundamental groundwork of pattern in nature may be the means of drawing out many primitive imaginings and fears, which may find symbolic expression through the medium of art. The attitude of the Australian aborigine to natural shapes comes to mind in this connection.

Whether this be the explanation of the existence of the 4th stage at least it is clear that in this stage we may place primitive works of art, whether by primitive peoples or by moderns consciously working in the same idiom—works in which expression is firmly rooted in the strong lines of pattern and in which the symbolic element is uppermost. In what we may judge of the work of Paleolithic times, in the arts of Egypt, Sumeria and Mycenae, in the arts of the East as well, particularly in the primitive arts of Africa and Polynesia, we see the tendency exhibited. It pervaded the arts of Europe (with the exception of the Graeco-Roman interlude) until the Renaissance, and persisted long afterwards, and gives a distinct character to much of contemporary painting.

The 3rd stage may co-exist with a good deal of this formal expression. The reduction of the size scale is a curious and perhaps unexpected phenomenon.

One of the first adjustments of vision is that which correlates size and space, and the imaginative life of children finds free play in the reduced world of toys. Thus there is a well recognized stage of development when a world of Lilliputian stature is created, into which the child enters and relives its imaginative experience. This self-absorption in a world of small objects can clearly persist into adult life. It is, for example, manifested in the world of puppetry and in certain well-defined aspects of the ballet, in which folk memories are evoked in terms of a symbolism less than life size. It has already been said that this tendency is shown widely in primitive work, and it is well illustrated in the drawings of medieval times, such as those which accompanied illuminated manuscripts. Indeed, it is interesting that "Lilliputian" man should walk the stage so evidently in Gothic times before his stature was noticeably raised by the liberal humanism of the Renaissance. The medieval Church reduced man to a mere puppet in the hands of God and his viceregents; and it took the New Learning to place man in possession of his world. Yet what he gained in freedom and stature he lost in security, and such "3rd stage" manifestations as occur to-day may well be an unconscious reversion to the security of a world in which man is an altogether smaller being—his potentialities reduced, and less fraught with the awful possibilities which freedom has brought within his grasp.

The 2nd stage may be said to take its starting-point from the awareness of deep space in which are set objects of solidarity and roundness. The realization of this in painting is essentially a European achievement and, historically, Masaccio is usually cited as the artist who inaugurated this phase. In his paintings we see the first strivings to establish rounded figures in true spatial surroundings, and organized around some central theme. This realization of depth and solidarity was continued through Renaissance and High Renaissance times; yet at first, and to some extent until the 19th century, much of the individual treatment of figures has a symbolism which belongs to Stage 4. The continued study of the human figure led to its more complete realization as solid rounded form in space, until it was liberated entirely from the formal patterned setting of more primitive work. What the figure gained in objectivity, acquiring in flesh and blood, it lost in sheer force of elemental expression; it was "held" on the canvas no longer by strong defining lines and shapes, but by action, gesture, or the psychological expression of character—in other words by the "theme" which supplied the *raison d'être* of its presence in the picture. The tendency is away from the symbolic expression of experience, from awareness of nature as a direct means of communication, and towards the recapitulation of detail and narrative by means of naturalistic association.

There is but a step between the "highest" manifestations of Stage 2 and those manifestations of complete naturalism represented in Stage 1, in which nature is taken as it is found and simply recorded, the human agency being suppressed as far as possible, except in so far as skill is exercised to give expression to the recognition of unrelated objects. The beginnings of photography in the 19th century left their mark on the art productions of the period, and led to the development of paintings which were wholly photographic in intention—mere reproductions of fragments of nature by tonal treatments of light and shade. Against these tendencies, and those of the photographic-thematic treatment of nature, the modern movement is a conscious revolt, a re-assertion of painting as standing essentially for an independent vision, as having something to communicate about the nature of reality. The modern movement has been a deliberate harking back to more primitive modes of seeing—in fact, in the main, to Stage 4. It is for this reason that it sometimes meets with such violent opposition from its critics, among whom may be numbered the apostles of "progress." The "progress" of man seems more in keeping with a sophisticated and factual vision, which serves more and more the ends of biological function; and what Roger Fry called a "biological blasphemy"—the use of the eyes to see nature imaginatively—seems a weakening of those forces which keep man in confident control of nature, and of his sanity. Such an attitude thrusts the world of nature, in any sense of a living entity, more and more into the background of human life, puts man in a false relation to his environment, and cuts him off from any vital connection with the traditions of the past.

In outlining these phases of culture in historical perspective, we have been concerned with broad general tendencies. Probably all the stages have in some sense existed co-extensively with those which have predominated at particular periods. For instance, the recurrence of naturalism has already been commented on, with its flowering in the later Grecian period, being in turn taken over, but not

creatively added to, by the Romans; and similarly the overlapping of the 4th and 2nd stages has also been mentioned. Nevertheless it has been shown that it is possible to relate the different stages to the culture-patterns of past ages.

One recurrent phenomenon which has been noted in connection with the ether abreaction technique has so far been mentioned only by implication. It is the phenomenon of what, in the papers previously referred to, has been described as the "Watcher." The patient undergoes a dissociation of his "self," so that whereas part of him reverts, as it were, to the actual time and place of the events he is re-enacting, another part is conceived as an onlooker "watching" these events. (A third part is also identified with the patient's actual situation while undergoing treatment—that is, a person lying on a couch and maintaining conscious contact with the doctor.) The "Watcher" is not clearly defined in form and is not associated with a definite body, but it is located in space and is envisaged as being above, behind, and slightly to one side of the person being watched. The "Watcher," then, is clearly a manifestation of self-awareness, such that it is possible to distinguish between a "self" which watches and a "self" which is watched. These two selves are closely related, but they are clearly differentiated as distinct entities, and the "Watcher" self is scarcely a neutral observer: it is an operative "I," which is in some sense critical of the activities of the "me" which it watches.

Two problems arise here. First there is the distinction made between separate "selves" within the complex of one individuality, and secondly there is the specific feature exhibited by the "Watcher" self with the concomitant experience of self-awareness. It is, therefore, of interest to inquire whether there is in ordinary experience, and in patterns of culture which are the embodiment of experience, anything which illuminates or illustrates these problems. In this connection it is worth giving some attention to expressions which have passed into the common coinage of language, for we may be sure that they do represent, however inadequately or indefinitely, some basic common trends of experience. Indeed, it is only to be expected that fundamental experiences which impress themselves on the consciousness of man will eventually find expression in language—not the technical language of the philosopher, but the familiar language of the "workshop and the counting house." However much these workaday expressions of experience may be deemed inadmissible when subjected to the refinements of logical and grammatical analysis, it is certain that at the least they betoken the existence of states of awareness which, though they may not be consciously or intellectually grasped, are none the less real and deeply felt. There are, for instance, expressions like "my better self," which assume the existence of more than one "self"—one, moreover which is morally superior to, and so by implication passes judgment on, the other. Then again, we speak of a person being "beside himself" with grief or anger—a significant expression in the sense that it assumes that there is a self which becomes separated in space from another, under the influence of some strongly emotional experience. A person may also be described as getting "above himself"—and how can "above" have meaning unless a "self" is postulated which remains in some sense "below"? As more directly connected with creative experience we may speak of "self-expression," which implies that a self can be symbolized in an expressive act and therefore dissociated from the self which is performing the act of expression. This is merely a more technical way of stating the simple popular notion that a person can "put himself" into his work.

This "putting himself" into his work is exactly what the artist is assumed to do, but what is often lost sight of is that the artist plays an essential role as observer and assessor of what is symbolized in expression, and this, it may be presumed, is always accounted in some degree imperfect, limited, and falling short of an ideal. Thus the expressive act becomes at the same time an act of self-awareness, and the very existence of a work of art is evidence of an aspect of "self" which is critically "watched."

The observer-symbol relationship is so fundamental to creation and is so integrated with the creative process that it is not often that the theme is treated as a conscious item in a work of art. It is taken for granted and not consciously portrayed. Nevertheless, the theme has at times been attempted, and we may note that some contemporary British painters have been at pains to emphasize in figure studies the notion that the central figure of the picture is actually under observation. The following are extracts from an article which appeared in *The Observer* for 12 December, 1951, written by its art critic Mr. Neville Wallis:

- o "The failure to communicate profoundest fears and longings to an unresponsive mind is not only a domestic tragedy, but to-day a cosmic problem. Can this idea, so easily expressed in words, be also expressed pictorially with clarity and force ?

"Michael Ayrton has a recent painting of a man seeking to establish a bond of sympathy with a woman who is identified with the spectator and therefore invisible—save for her reflection which gazes, silent and uncomprehending, from the mirror above the mantlepiece. For much longer this agony of frustration has been the recurring theme of Francis Bacon, his victims being usually divided from us by a transparent cube which imprisons them. . . . His works consist of three entirely free and individual versions of Velasquez's "Innocent X," an equally large painting of Lucien Freud, a nude figure, adumbrated yet substantial, before a grey curtain, and a smaller picture of a man appalled by the image of himself as an ape. In the Innocent paintings all the outward symbols, the purple mitre and cape, the glitter of the throne, are contrasted ironically with the Pontiff's spiritual withdrawal and, in one instance, with a fugitive expression seemingly caught unawares by a press photographer. This time the figure is isolated by the barrier of a curtain-rail. . . . As remarkable is the Freud full-length portrait, which seems to owe more to the flickering silent screen than to flashlight photography, with long shadows . . . cast by us, spectators still out of reach, across the foot of the bare canvas. . . ."

A "Watcher" symbolism is also present in several of Gauguin's paintings, as for instance in "The Spirit of the Dead watches," where an almost spectral figure silently contemplates the girl lying on a couch. Picasso has several pictures on the theme of "the artist and his model." In one of these (1928) the highly symbolized painter is seated before an equally symbolized model, while the profile which he has drawn on his canvas is naturalistic—a conscious (and perhaps humorous) reversal of the normal relationships of art and nature. In a drawing entitled "Painter and a Model Knitting" (1927) the painter is seated before the knitting figure, both being treated naturalistically, while what the painter draws is seen to be an abstraction. In a "Portrait of the Author" which Picasso drew for a published version of his play "Le Désir attrapé par la queue" he has selected as a vantage point for a self-portrait a position above and slightly behind himself. It is significant that he is evidently able to "see himself" from this point of view. Picasso has also dealt with the mirror-image theme, and in one of his most important compositions, the "Girl before a Mirror" (1932), the girl, whose profile and full face are superimposed, is "watched" by the profile of her image in the glass. Commenting on this picture the American critic, Alfred H. Barr, writes as follows ("Picasso; Fifty Years of his Art," *The Museum of Modern Art, New York*, 1946, p. 176):

"Of all Picasso's paintings of the early 1930's this is one of the most elaborately designed and sumptuously painted. Its magnificent colour, heavy dark lines, and diamond-patterned background call to mind Gothic stained glass. The intricate metamorphosis of the girl's figure . . . and its image in the mirror, the paradoxical tension between a subject of quiet contemplation and a composition of maximum activity in colour and design, all suggest poetic and metaphysical implications rare in Picasso's art of this period."

Picasso here, then, is not painting a mere reflection in a mirror: the image is another "self" which contemplates the figure before it. This self-dissociation and indeed self-awareness has been a recurrent theme in Picasso's work, for his constant preoccupation with the "double face"—profile and full face superimposed—is in effect the portrayal of two selves in the one individual, both of them closely related, and the one, moreover, often suggested as contemplating the other.

There are many examples in literature of the experience of self-dissociation. A striking case occurs in *The Seven Pillars of Wisdom* where Lawrence, in describing an occasion when he was subjected to extreme physical exhaustion, recalls his experience as follows:

"Now, I found myself dividing into parts. There was one which went on riding wisely, sparing or helping every pace of the wearied camel. Another hovering above and to the right bent down curiously, and asked what the

desh was doing. The desh gave no answer, for, indeed, it was conscious only of a ruling impulse to keep on and on, but a third garrulous one talked and wondered, critical of the body's self-inflicted labour and contemptuous of the reason for effort."

Enough has been said to justify the belief that there is a real connection between the "Watcher," which is revealed with such certainty in the ether abreaction technique, and certain aspects of experience; that, in other words, there are modes of experience which gain in meaning by the conception of a "Watcher" self which may be differentiated as a separate entity within the framework of personality.

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ACUTE PORPHYRIA PRESENTING WITH MENTAL SYMPTOMS.

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ACUTE porphyria is a rare disease in this country. Although a typical case was described in the *Journal of Mental Science* over 50 years ago (Campbell, 1898), Petrie (1948) could find only three cases reported in Britain between 1940 and 1948; since then at least six more cases have been reported. The disease is relatively common in Scandinavia and, to a less extent, in North America—a distribution for which Discombe (1948) has suggested an explanation in terms of relative emigration rates.

Scandinavian workers (Waldenström, 1939; Jørgensen, 1947) consider that acute porphyria is a metabolic disorder inherited as a Mendelian dominant but with a low manifestation rate. Waldenström observes, however, that the extensive paralyses which have been associated with recent cases hardly occurred in previous generations, and he concludes that the severe attacks which are now characteristic of acute porphyria are probably due to the effect of drugs, especially the barbiturates, reacting with the abnormal metabolites to form toxic products. If this is so, then cases of acute porphyria are likely to occur particularly in mental hospitals, where barbiturates have become the principal routine sedatives and where they are often given continuously for many weeks.

The classical symptoms of acute porphyria are abdominal pain, limb paralyses, mental changes, and excretion of dark-red urine, but the symptoms may be extremely varied, not only in different individuals, but in the same individual in different attacks. The neuropsychiatric aspects of acute porphyria have been discussed by Waldenström (1939), Roth (1945), and Becker (1951). The cases described below were admitted to a mental hospital because the psychiatric symptoms predominated; the first case presented as a toxic-confusional psychosis, and the second as a post-operative depression with pain and weakness suggestive of hysteria.

CASE REPORTS.

Case 1.—A married woman, aged 25, was admitted to a general hospital on 2.vii.50 on account of abdominal pain and vomiting. Six days before admission she had developed anorexia with vomiting and diarrhoea; three days later she had become constipated and complained of colicky abdominal pain. Examination revealed tenderness and guarding in the right iliac fossa. Appendicitis was diagnosed, but at operation the appendix was found to be normal, and nothing was discovered to account for the symptoms. The pain was relieved by the operation and the patient made an uneventful recovery, but her urine was noticed to be abnormally dark. Tests for urinary porphyrins and porphobilinogen were positive and the urine was found to contain protein, cells and granular casts. On 18.vii.50 porphyrins were still present in the urine, but protein, cells and casts were now absent. She was discharged from hospital after a fortnight.

On 4.iv.51 she was admitted as a voluntary patient to a mental hospital with the following history: Three weeks before admission she had awoken in the night screaming and apparently believing there was a man in her bed (her husband was abroad). From that time she behaved abnormally, stated she could see men with "staring grins" at the window, refused food, and seemed strangely preoccupied. According to her mother the patient then gradually lost the use first of her legs and then of her arms, became doubly incontinent and suffered from vomiting, diarrhoea and epimenorrhoea. A psychiatrist was called to see her and she then claimed to be too weak to stand, although on testing she was able to walk with only the slightest assistance. She was considered to be suffering either from an acute anxiety state or from early schizophrenia. On admission two days later the patient was stuporose and unable to give any account of herself. Her parents stated that she had always been a quiet, dependent sort of person, and that, except for the attack of "appendicitis," she had had no serious physical illness and never before had a nervous illness. She was one of six children and no relevant family history was obtained. Physical examination revealed

gross distension of the abdomen, which was tympanitic to percussion; the tendon reflexes were present and equal but much diminished; there was marked generalized muscular weakness, although sensation was unimpaired. Her blood urea was 271 mgm. per cent., and the urine contained granular and hyaline casts but no protein and no blood. The urine was dark red in colour, but the significance of this was missed at the time (the report of her previous admission to the general hospital was not then available). Her condition rapidly deteriorated and she died two days after admission. Post-mortem examination revealed pulmonary oedema and kidneys of normal weight but some scarring and loss of distinction between cortex and medulla; no sections were cut.

In this patient's second illness, the diagnosis of acute porphyria has to be made retrospectively, but when the facts of her first illness, together with the muscular weakness, red urine and absence of gross post-mortem changes are considered, this diagnosis appears extremely probable.

Case 2.—A married woman of 42, who complained of heavy menstrual periods, was found to have fibroids and underwent an operation for total hysterectomy and bilateral salpingo-oophorectomy on 21.i.52. A week later she had a small secondary haemorrhage and on the next day became restless and agitated, running her fingers through her hair, picking at the bedclothes, refusing to eat and vomiting everything she took by mouth. A psychiatrist diagnosed post-operative anxiety-depression and, because her mental condition became worse, she was admitted as a voluntary patient to a mental hospital on 5.ii.52.

On admission her only complaint was of generalized weakness. On examination she looked pale and ill and her pulse was rapid (130), but otherwise there were no abnormal physical signs. In spite of her emphasis on the weakness of her limbs, she could, with an effort, walk unaided, and she gave the impression of affecting extreme fatigue. Her conversation was rational, and it was evident that she feared her recent operation might have been for cancer, for her mother had died from cancer of the uterus two years before, and the patient, while in the gynaecological ward, had been nursed by the same ward sister who had nursed her mother. She had had no serious physical illness in her life, and although always of a reserved and worrying nature, had never been under a doctor for her "nerves." There was no relevant family history. She repeatedly said that she would never get well again, that she was going to die and that she had no desire to live.

Investigations showed a reddish-brown urine containing protein, pus and red blood-cells and a few cellular casts; on culture *Bact. coli* was grown. Her blood urea was 71 mgm. per cent. and the blood-count was within normal limits. On 7.ii.52 she complained of pain from her neck to her umbilicus, and two days later began to be drowsy during the day-time, though restless and agitated in the evenings. Her urine continued to be dark-red; it now contained only a few red cells, but a marked increase of urobilin. Her muscular weakness increased, and examination on 19.ii.52 revealed complete loss of all her tendon reflexes, though no loss of sensation or co-ordination. The thigh muscles were obviously wasted and there was increased pigmentation of the skin. Double incontinence developed, and she continued semi-stuporose by day, restless and frightened at night. Her cerebro-spinal fluid was clear, under normal pressure and contained protein 60 mgm. per cent., globulin increased and lymphocytes 1 per cmm. Her blood urea was 71 mgm. per cent., blood potassium 25 mgm. per cent. The urine was tested for porphyrins with negative results, but specific tests for porphobilinogen were not made. Because her generalized muscular weakness was increasing and respiratory paralysis was feared, she was transferred on 21.ii.52 to a general hospital where a mechanical respirator was available. In this hospital uroporphyrins were detected in the urine. After being very ill for many weeks she gradually improved and was discharged home on 6.v.52. When seen a month later she was well, although still somewhat unsteady on her legs; her urine was normal in colour and contained no porphyrins.

Hart and Collard (1950) have described a similar case in which a woman of 45 developed progressive paralysis with porphyrinuria shortly after an operation for subtotal hysterectomy; in their case, however, the mental symptoms were evidently less severe.

DISCUSSION.

Waldenström (1939), who has had extensive experience of acute porphyria, states that many of his cases have been sent to an asylum for their psychotic symptoms. A study of the literature indicates that severe mental disturbances occur in about one-quarter of the cases. There are two characteristic psychiatric pictures: a toxic-confusional psychosis and a state of anxious depression with what at first sight seem to be hysterical complaints of pain and weakness.

The toxic-confusional psychosis is presumed due to actual brain-damage. It may be associated with stupor, convulsions, delirium and hallucinations, and on account of the latter symptoms a diagnosis of schizophrenia is sometimes made (e.g., Davies, 1949). Where the picture is that of an affective reaction, it is usually associated with paresis and the patient complains of extreme weakness—a com-

plaint which is especially liable to be thought hysterical, because, as Waldenström observes, "the pareses initially manifest themselves as a curious feebleness that can be overcome by a strong volitional act." This "curious feebleness" was present in both the cases recorded here.

According to Roth (1945), acute porphyria tends to occur in persons of neurotic constitution and in whose families there is an abnormally high incidence of psychoses. In the present cases no family history of psychosis was elicited. Both patients were said to be of nervous disposition, but in Case 1 the patient showed no signs of neurotic reaction during her first attack, while in Case 2 the picture was more that of affective lability occasioned by a toxic state than of a neurotic reaction to illness.

The diagnosis of acute porphyria is made certain by the demonstration of uroporphyrins or porphobilinogen in the urine (Jørgensen, 1947; Discombe, 1948), but, as Nesbitt (1944) has said and others have reiterated, the diagnosis will not be made unless the condition is borne in mind. Acute porphyria should be considered when an obscure psychiatric case is associated with one or more of the following signs: a toxic-confusional state, weakness and wasting of the limbs, complaints of severe pain, incontinence or retention of urine, and a urine of dark-brown or red colour. The red urine, although most characteristic, does not always occur. If the urine is alkaline, it may be normal in colour when passed and darken only on standing and acidification. In such cases, however, the colourless urine will usually (if not always) give positive tests for porphobilinogen (Watson and Schwarz, 1941). A number of cases have been reported in which the clinical signs pointed to a diagnosis of acute porphyria, but where uroporphyrins were never detected in the urine (Schie, 1939; Roth, 1945; Denny-Brown and Sciarra, 1947). There is no mention in these case-reports, however, that tests for porphobilinogen were made. Such cases have been described as "porphyria without porphyrinuria." A similar case was recently under my care:

Case 3.—A married woman of 39 was admitted as a voluntary patient on 15.ii.52 with a four months' history of increasing depression, fears that she might die or kill people, and unsteadiness of her limbs. On admission she was mildly ataxic and her knee- and ankle-jerks were absent, but her general condition was good, and a diagnosis of anxiety state with hysterical features was made. Carbon dioxide therapy did not cause any improvement and E.C.T. was begun, but her condition grew worse; the ataxia increased and she became dysarthric, made facial grimaces, and developed much retention and, later, incontinence of urine. These symptoms were followed by the onset of generalized paresis, and on 7.iv.52 she was too weak to sit up. By 22.iv.52 there was marked muscular wasting, especially of the hand muscles, and pigmentation of the skin; both legs became oedematous, and there were spasmodic twitchings of her sternomastoids and shoulder muscles; mentally she continued restless and distressed and suffered from severe insomnia, but was rational. Her blood-pressure was diminished (100/65), but the pulse-rate was normal. There was slight, irregular pyrexia. The blood chemistry, cerebrospinal fluid, and X ray of chest, skull and pelvis, were within normal limits. There was no clinical response to nicotinic acid, and tests for arsenical poisoning were negative. Serial blood tests now revealed an increasing anaemia and the bone-marrow picture was suggestive of pernicious anaemia. Injections of liver extract were followed by a typical reticulocyte crisis, but her clinical condition did not improve. She developed a urinary infection and broncho-pneumonia and died on 30.v.52. Permission for post-mortem was refused. The diagnosis of acute porphyria was considered almost from the start, but, although during the greater part of her illness the patient's urine was dark and contained an excess of urobilinogen, repeated tests for porphyrins and porphobilinogen were negative.

The possible relation of acute porphyria with such conditions as delirium tremens and infective polyneuritis has been discussed by Denny-Brown and Sciarra (1947), who postulate a common underlying metabolic dysfunction, while Scobey (1948) has maintained that there is a close relation between acute porphyria and anterior poliomyelitis. Nevertheless, in view of the protean manifestations of acute porphyria, it would seem advisable at present to restrict that diagnosis to cases where uroporphyrin or porphobilinogen is demonstrated in the urine.

Of great importance in suggesting the diagnosis of acute porphyria is a history of previous attacks. Acute porphyria is a disease characterized by exacerbations and remissions, and any patient who has recovered from one attack is liable to another, which may present with entirely different symptoms (as happened in Case 1).

There is no known specific treatment for acute porphyria. In Case 2 the accepted procedure of withholding barbiturates and sulphonamides was adopted as soon as the diagnosis was made, but without obvious influence on the clinical course.

SUMMARY.

Two cases of acute porphyria presenting with mental symptoms are described. A case clinically resembling acute porphyria, but without porphyrinuria, is also described.

The psychiatric manifestations of acute porphyria and the factors which, in psychiatric cases, suggest the diagnosis, are briefly considered.

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THE ROUTINE USE OF MUSCULAR RELAXANTS PRIOR TO ELECTRICAL CONVULSIVE THERAPY.

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It is probable that the incidence of vertebral fractures during E.C.T. is greater than was formerly thought to be the case. Meschan, Scruggs and Colhoun (1950) found vertebral compression fractures in over 35 per cent. of 212 cases treated with E.C.T. Plattner (1949), in a series of 500 cases (200 men and 300 women), found fractures in 58 (37 men and 21 women). In 20 of his cases E.C.T. had to be abandoned on account of the fracture.

Some psychiatrists may feel that vertebral fractures are not so common as these figures would suggest. The reason for this may be that many slight compression fractures do not immediately produce severe pain, and hence pass unnoticed. We fear that ultimately, perhaps after some years, unpleasant arthritic changes may develop in such patients.

Besides the strain on the skeleton, the cardio-vascular system is also subjected to stress during E.C.T. as there is an elevation of blood-pressure during the seizure. Arterio-sclerotic and hypertensive patients—now requiring treatment in increasing numbers—run a special risk on this account.

The relaxants in common use have been those of the curarizing type such as gallamine triethiodide ("Flaxedil") and d-tubocurarine chloride ("Tubarine" or "d-TC"), and those of the depolarising type such as decamethonium iodide ("Eulissin P"). The mode of action of these two groups is compared in a paper by Paton and Zaimis (1950).

Certain disadvantages of the curarizing type of relaxant are :

1. That muscular relaxation often outlasts the period for which it is required, and this may be serious where prolonged respiratory paralysis is involved.
2. That side effects occur, attributable to the release of histamine and heparin.
3. That the relaxation secured by safe dosage is not always adequate.
4. That the injection of prostigmin as a routine antidote to curare is not without danger, as it is in itself a powerful drug capable of producing undesirable side-effects.
5. That the ordinary d-tubocurarine is not miscible with thiopentone, which is usually given along with it to avoid the unpleasant subjective sensations accompanying muscular relaxation.
6. That the delay of four or five minutes with each patient while curare is taking effect means an appreciable loss of time when a number of patients are being treated.

Trials with Decamethonium Iodide.

Decamethonium iodide has a similar relaxing effect to curare, although it is dissimilar pharmacologically. This drug has now been tested clinically and favourable results have been reported from Davies and Lewis (1949), Grob, Holoday and Harvey (1950), Hobson and Prescott (1949), and Unna *et al* (1950). The principal advantages are a briefer duration of action and a relative freedom from side-effects. Recently, however, undesirable cardio-vascular and respiratory complications have been reported (Guerrier and Mason, 1952). Unlike curare, decamethonium iodide may be mixed in the same syringe with thiopentone, and it may be injected rapidly. The principal disadvantage is the absence of an effective antidote.

We have used decamethonium iodide—"Eulissin P"—in 40 cases (25 females and 15 males), ages ranging from 21 to 73. In all, 234 treatments were given. In six cases only was relaxation regarded as inadequate. In three of these cases the patients were unusually muscular and the other three were elderly. In each of these

cases, a simple adjustment of the dosage brought about satisfactory results. All but one of the 40 re-commenced respiration promptly, and with this one the difficulty was subsequently overcome by reduction of the dosage of decamethonium iodide. Oxygen was given by forced insufflation of the lungs in every case until respiration recommenced. No side-effects attributable to the drug were seen except in one elderly male who had attacks of diarrhoea following each treatment. All except three of the patients accepted treatment readily. One of these three based his fear on a previous acquaintance with curare, one was inordinately apprehensive in general, and the third was a paranoid schizophrenic.

In 14 cases blood-pressure readings were taken—

- (1) immediately before the injection,
- (2) just before the administration of the electrical stimulus, and
- (3) just after the seizure.

In each case the second reading was lower than the initial one, the reduction being 10–40 mm. Hg for the systolic and 0–30 mm. Hg for the diastolic. In five cases there was an increase of both systolic and diastolic pressures immediately after the seizure, the systolic being raised by about 60 mm. Hg and the diastolic by about 20 mm. Hg. In the other cases the blood-pressure was simply restored to its pre-injection level.

We concluded from these results that decamethonium iodide ("Eulissin P") was a satisfactory relaxant. We believe that the absence of an antidote is not a serious contra-indication, provided facilities are at hand to give oxygen effectively. A potential risk would seem to be irreversible C.N.S. changes due to cerebral anoxia occurring as a result of inadequate inflation of the lungs.

Preliminary Trials with "Scoline."

Experience with decamethonium iodide for routine use under nursing-home conditions encouraged us to try succinylcholine chloride (Syn. Succinoylcholine Chloride, Suxamethonium Chloride, or Succimethonium Chloride) or "Scoline" (Allen & Hanbury). This substance is an ultra-short-acting muscular relaxant of the depolarizing type. It has recently been the subject of a report by Bourne, Collier and Somers (1952). Reports of "Scoline" both in anaesthetic practice and as a relaxant for E.C.T. are favourable (Brucke *et al.*, 1951; Thesleff, 1951; Mayrhofer, 1952; Richards & Youngman, 1952). Recently prolonged respiratory paralysis has been reported (Harper, 1952; Hewer, 1952; Hurley and Monro, 1952; Grant, 1952) following "Scoline," but there seems to be no other serious complication recorded. This danger is rare, and we have not met with it in our series.

An initial trial under nursing-home conditions was carried out. Thirty-four patients (12 males and 22 females) were treated, a total of 183 treatments being given in all. These were predominantly cases of depression occurring in the involutional period. They were drawn from the upper income groups, and were probably of rather higher intelligence than the average. They were certainly exacting, and capable of formulating criticism. Many had had previous experience of unmodified E.C.T., and a few had had other relaxants previously. Almost without exception these patients expressed a preference for our technique using thiopentone and "Scoline."

Of these 34 patients, 9 were so frail, aged or physically ill that we judged them to be unfit to stand a course of unmodified E.C.T.—(these are included in Table IV). None suffered any detectable ill-effects which we could attribute to E.C.T. as modified by thiopentone and "Scoline." Observations carried out during this trial period confirmed the findings of other workers (Bourne, Collier and Somers, 1952) in general, and are not recorded in detail in this paper, with a few exceptions (*vide infra*).

The Routine Use of "Scoline."

Following preliminary trials it was decided to introduce "Scoline" as a routine premedication for all E.C.T. in the mental hospital. This method has now been used by us for six months, and our experience is summarized in Tables I and II.

In general, modified E.C.T. has been as effective therapeutically as unmodified E.C.T., though in a few cases this was apparently not the case. This apparent discrepancy is now being investigated, and we hope to make it the subject of a subsequent report.

TABLE I.—*Numbers of Patients Treated.*

	Modified E.C.T. (preliminary trials).	Modified E.C.T. (routine).	Unmodified E.C.T. (during previous 6 months).
Males . . .	12	111	66
Females . . .	22	199	125
Total . . .	34	310	191

TABLE II.—*Numbers of Individual Treatments Given.*

	Modified E.C.T. (preliminary trials).	Modified E.C.T. (routine).	Unmodified E.C.T. (during previous 6 months).
Males . . .	57	877	627
Females . . .	126	1560	1149
Total . . .	183	2437	1776

Susceptibility to "Scoline."

In two cases relaxation was insufficient using the recommended dosage and a substantial increase (to more than double the usual dose) was necessitated. One of these patients, a woman weighing 160 lb., eventually received 85 mgm. of Scoline with only slight modification of the seizure. The other case was a lean and muscular man, who was fairly well relaxed at exactly twice the original (recommended) dosage.

In three cases the initial dose was slightly reduced. Two of these patients were markedly wasted, an observation in keeping with the reports of Bourne, Collier and Somers (1952), who regard malnutrition as a causal factor in hyper-susceptibility to "Scoline." The serum cholinesterase was not estimated in our cases.

In every other case the dosage recommended by the manufacturers was found to be satisfactory.

Immediate Effects of "Scoline."

(a) Respiratory : We have not encountered the prolonged respiratory paralysis reported by other workers (Harper, 1952 ; Hewer, 1952 ; Hurley and Monro, 1952 ; Grant, 1952). The longest period of apnoea was five and a half minutes.

(b) Blood-pressure : In 25 cases the blood-pressure was recorded (1) immediately before the injection, (2) immediately before the electrical stimulus, and (3) as soon as possible after the seizure. The results were very variable. The injection was generally followed by a slight fall in pressure and the electrical stimulus by a slight rise, but no really constant pattern emerged. The readings in each case could well have been accounted for by the effects on the musculature. This is in keeping with the findings of Somers (1951) quoted by Bourne, Collier and Somers that the blood pressure of the cat is not affected with ordinary dosages.

(c) Fractures : During the control period ten fractures of the bodies of vertebrae are known to have occurred, and we have no guarantee that milder cases were not missed. There was at no stage any suggestion of a fracture in the patients treated by modified E.C.T. It occurs to us as a potential danger, however, that staff becoming familiar with the very mild seizure of modified E.C.T. may relax precautions to the detriment of the rare case who, through insusceptibility to "Scoline," does have a strong convulsion.

Apparent Delayed Effects of "Scoline."

Frequent detailed examinations of all patients undergoing modified E.C.T. has been impracticable. All unusual occurrences have, however, been investigated and

recorded. The vast majority of these were certainly unrelated to "Scoline." Symptoms which may prove to be significant are summarized in Table III.

TABLE III.—*Incidence of Complaints Following E.C.T.*

Complaint.	Modified E.C.T.			E.C.T. unmodified.
	Males (1,027).	Females (1,879).	Total (2,906).	
Fractures	0	0	0	10
Muscular pains and stiffness	15	5	20	?
Headache	5	9	14	?
Dizziness	2	5	7	2
Sickness	3	9	12	3
Dyspnoea	1	5	6	1
Rash	2	3	5	0
Haematemesis	1	2	3	1

(a) Haematemesis: Three patients on treatment with "Scoline" suffered moderately severe haematemesis. All three cases gave a history vaguely suggestive of peptic ulceration. In one there was a history of cerebral thrombosis two years previously, and in another there was a history of coronary thrombosis one year previously. In the latter two instances we gave E.C.T. with some misgivings, and made a particular point of ensuring efficient inflation of the lungs with oxygen.

The relationship of these serious occurrences to "Scoline" and E.C.T. is not clear. At first sight a causal connection is unlikely, but taken in conjunction with the incidence of anorexia, nausea and vomiting it seems that treatment cannot be excluded as a possible precipitating cause. It may be that during inflation of the lungs with oxygen after the seizure some of the gas occasionally enters the stomach. Gastric distension produced in this way might account for the disaster in a patient predisposed for any reason.

(b) Sickness (including anorexia, nausea and actual vomiting): This was an occasional source of complaint, though invariably a transient phenomenon. It may have been related to gastric distension by oxygen, though actual eructation of wind was rare.

(c) Headache: This was certainly very much less common following modified than following unmodified E.C.T. No reliable figures are available for the control period, as post-convulsive headache was rarely recorded, though known to occur frequently.

(d) Muscular discomfort: This, too, was formerly very common, though rarely recorded. It was certainly much less frequent following modified E.C.T.

(e) Rash: A morbilliform rash occurred once after a patient's first treatment and four times after fourth or fifth treatments. It appeared about eighteen hours after treatment on each occasion and lasted from two to six hours. It is known that histamine is released in small quantities by "Scoline" (Bourne, Collier and Somers, 1952), but in none of our five subjects was there any other evidence to suggest histamine release, and the rash was never typically urticarial in appearance.

(f) Dizziness: This was a mild symptom, occurring during the few hours immediately following treatment. There was neither deafness nor tinnitus, and the symptom did not amount to true vertigo.

It is of interest to note that the "confusional" period immediately following E.C.T. was apparently reduced by the use of a relaxant, although we have no statistical support for this observation. Presumably, as in the normal individual, the presence of tired, aching muscles tends to discourage an early return of full consciousness. This will be of significance more particularly in out-patient work.

Absence of Contra-indications.

Of the total number (397) of patients treated by modified E.C.T. 77 had physical disabilities which would ordinarily have contra-indicated E.C.T. These are recorded in Table IV.

Apart from the three cases of haematemesis already mentioned, no complication or aggravation of an existing disability occurred.

TABLE IV.

Patients physical abnormality.	Number treated.	
	Male.	Female.
Hypertension (over 90 diastolic)	12	23
Other cardio-vascular disease	3	6
Organic brain damage	2	5
Old age, debility, etc.	5	11
Rheumatoid arthritis	3	4
Recent surgery	1	1
Puerperium	—	1

Technique.

The choice of technique is dictated so largely by local conditions and by individual preference that a detailed description would be superfluous and presumptuous. Suffice it to say that we have been able to treat an average of fifteen patients an hour without haste and without running risks.

No routine premedication is employed. We attach great importance to an empty stomach, however; vomiting (before respiration is restored) is a potential disaster.

We employ the dose of "Scoline" recommended by the manufacturers (Messrs Allen & Hanbury) and have rarely found it necessary to alter this. Thiopentone and "Scoline" mixed in the same syringe are effective if given promptly, but we prefer to use separate syringes and a single needle. This obviates occasional unpleasant sensations attributable to the effect of "Scoline" preceding unconsciousness.

In the generalized muscular twitching which appears about fifteen seconds after the injection of "Scoline" we have never seen violent movements occur. We have, however, frequently noted semi-purposive movements apparently organized at a fairly high neurological level. We attribute these to thiopentone, and regard them as the "excitement stage" of anaesthesia.

Full relaxation follows the disappearance of the mild twitching movements; an additional guide is the disappearance of the grasp reflex. Electrodes are applied and in some instances oxygen administered during the pre-relaxation phase. Following the electrical stimulus both tonic and clonic phases of the convulsion can generally be detected.

Immediately after the modified convulsion an airway is inserted and oxygen is administered through a close-fitting face-piece until a good colour returns to the skin. When respiration is satisfactorily re-established the patient is put to bed on his side. A careful watch is maintained until he is fit to walk.

No additional staff are called upon to administer this form of treatment, and from the point of view of convenience it is little inferior to unmodified E.C.T. An advantage is the use of two trolleys; while one patient is receiving oxygen the next is being prepared for the injection.

Summary and Conclusions.

The use of unmodified E.C.T. is attended by serious risks, which can be eliminated by the use of a suitable relaxant. Over a period of six months we have used "Scoline" on 2,437 occasions as part of routine treatment in a mental hospital. We find it a safe and reliable relaxant, convenient to use in conjunction with thiopentone in small doses.

We consider that unmodified E.C.T. is now out-moded.

We wish to thank the staff of the Wellwood Nursing Home, Cults and Aberdeen Royal Mental Hospital, and particularly Dr. Moyra Kemp for observations with "Eulissin P" and Dr. Bruce Stephen for assistance in the collection of clinical observations following treatments using "Scoline."

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(b) Given with thiopentone (because patients complained when the drug was given alone,) there was no obvious difference in the effects except a more marked diminution in respiration and a greater incidence of cyanosis after the fit. This was overcome without difficulty by routine administration of oxygen.

Modification of Fit.

This ranged from a slight but sufficient modification, which was enough to obviate the risk of fractures, to a state in which the patient hardly moved. The effect varied in the same patients from day to day with the same dosage. The apparent extent of the decrease in muscular tone before the convulsion was not always a guide to the degree of modification obtained during the convulsion, a patient sometimes being able to move a limb slightly and yet having a very much modified fit. When patients had recovered from the effects of the convulsion they were able to walk back to the ward.

Comparison with Succinylcholine.

For comparison 18 patients were treated with succinylcholine and thiopentone. As these drugs are not miscible the thiopentone was given first from a separate syringe. Dosage of both drugs was calculated on a weight basis and no case of hypersensitivity was observed.

- | | | |
|---|---|--|
| 1. Thiopentone 5 per cent. solution | . | $\frac{\text{Body weight in pounds} \times 1 \text{ c.c.}}{40}$ |
| 2. Succinylcholine 5 per cent. solution | . | $\frac{\text{Body weight in pounds} \times 1 \text{ c.c.}}{200}$ |

Effects.

The first sign, a fine twitching of the face, appeared in 10 to 15 seconds after completion of the injection; it was soon followed by loss of muscular tone and cessation of respiration. The convulsions could be given in about 45 seconds and oxygen was given immediately to prevent cyanosis. Breathing returned in two to four minutes and complete recovery of muscle tone in about five minutes.

Results.

No modification occurred in one patient on the first occasion, but good modification was obtained with the same dose on the next occasion. In another patient extra-systoles occurred, and a fairly deep cyanosis developed which was controlled by administration of oxygen. On all other occasions good relaxation (on the whole rather more marked than with RO/3/0386) was obtained and there were no untoward incidents. When patients had recovered from the effects of the convulsion they were able to walk back to the ward.

Conclusions.

RO/3/0386 appears to be a reliable, useful and safe relaxant for reducing the muscular force of electrically-induced convulsions which does not cause complete respiratory arrest. It has the advantage of being compatible with both thiopentone and atropine and mixed injections can therefore be given from the same syringe. From a small number of observations succinylcholine appears to be a reliable relaxant, but has the disadvantage that respiration ceases for a short time and that, succinylcholine being incompatible with thiopentone, it is necessary to use two syringes for the injection.

I am grateful to the Medical Superintendent of the Napsbury Mental Hospital for permission to publish this paper and to Dr. A. M. Edwards for his help and criticism. I should also like to thank Dr. F. Wrigley, Director of Clinical Research, Roche Products Ltd., Welwyn Garden City, for placing generous supplies of RO/3/0386 at my disposal.

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OBSERVATIONS ON THE SHORT-ACTING RELAXANT RO/3/0386.

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THE present investigation covers a series of 110 treatments with electroplexy in which RO/3/0386 has been used as an ultra short-acting relaxant. This is a heteropoly-methylene-bis-trimethylammonium diiodide, $\text{Me}_3\text{N} + (\text{CH}_2)_4 \cdot \text{S} \cdot \text{S} \cdot (\text{CH}_2)_4\text{N} + \text{Me}_3 \cdot 2\text{I}$ in aqueous solution which, being related to the decamethonium compounds, acts by depolarizing the motor end plate, and results in similar clinical effects to those produced by succinylcholine as described recently by Richards and Youngman (1952), Mayrhofer (1952), Bourne Collier and Somers (1952), and others.

The series was made up of 22 female patients ranging in age from 26 to 65 who were given courses of from 3 to 9 convulsions. All were voluntary patients suffering from varying degrees of depression who commenced this treatment within three weeks of admission. Two had arteriosclerosis of moderate severity, two had chronic bronchitis and emphysema, and one had had a detachment of the retina a year previously. All except two have been discharged as recovered.

TECHNIQUE.

The usual preparation is made for convulsion therapy, which is given in the morning with the patient fasting. One hour beforehand atropine $\frac{1}{100}$ gr. (0.65 mgm.) is given if there is evidence of bronchitis, and sodium amytal 3 gr. (0.2 gm.) by mouth if there is excessive apprehension. It appears unnecessary to take into account the weight of the patient in computing the dosage of the relaxant, but as a routine 4 mgm. of RO/3/0386 is given initially over a period of 10 seconds. Depending upon the degree of relaxation produced the dosage is subsequently adjusted to from 3 mgm. to 6 mgm. Within 30 seconds of injection there often occurs a mild feeling of suffocation, restlessness, or vague general discomfort. 40 seconds after completion of the injection the shock is given. The customary criteria of adequacy of fit are adopted, such as flickering of orbital and labial muscles, but the intention is not to abolish all convulsive movements but to reduce them to reasonable proportions. Some depression of respiration occurs, but the tendency to cyanosis appears to be less than with unmodified E.C.T., and oxygen, required in a minority of cases, is not given as a routine. Means of assisted respiration should, of course, be available in order to combat prolonged apnoea. I should add that this has not so far been necessary. Recovery from the relaxant is complete in less than 4 minutes after the injection.

DISCUSSION.

Complications such as prolonged apnoea or symptoms such as backache so frequent after ordinary E.C.T. have not been noted, and one has been impressed by the general "quietness" of the procedure, for which far less time is required than if the longer-acting relaxants such as gallamine triethiodide had been used. There has been willing co-operation on the part of the patients concerned, and it has been found possible with all to avoid the need for intravenous thiopentone by using psychological preparation, i.e., explanation, suggestion, reassurance, etc., before and immediately after the injection, although this might not be possible in every case. It was considered advisable not to give an intravenous barbiturate because of the cases of prolonged apnoea reported by Hurley and Monro (1952), Hewer (1952) and others when this drug has been used in conjunction with succinylcholine. At the present time there is no really satisfactory antidote to RO/3/0386, but owing to its very short action this is not a contraindication to its use. No significant changes in the blood pressure were detected in the present series and except with two of the patients there was less mucus and saliva produced than if E.C.T. had been given alone.

SUMMARY.

The ultra short-acting relaxant RO/3/0386 has been used on 110 occasions with electroconvulsion therapy.

Results compare favourably with those obtained from other relaxants.

It appears safe and well tolerated in the dosage suggested, and has little effect on the cardiovascular system.

ACKNOWLEDGMENTS.

I am indebted to Dr. F. Wrigley, formerly of Roche Products Ltd., for the supply of RO/3/0386, to Dr. C. S. Parker for his advice and criticism, and to Dr. A. R. Grant for permission to carry out this treatment.

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CELASTRUS PANICULATA IN MENTAL DEFICIENCY: A PILOT EXPERIMENT.

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Celastrus paniculata (*c. multiflora* and *c. mutans*) is a large climbing shrub found in the hilly districts of India, Burma and Ceylon. The seeds, leaves and an oil extracted by distillation are used in Ayurvedic medicine and are believed to increase intelligence. The Sanskrit name Jyotishmati or "light-bringer" is an allusion to this reputed property. Other members of the family Celastraceae, notably *Gymnosporia deflexa* Sprague and *Catha edulis* Forsk, are favoured by the natives of Africa as mental stimulants (Watt and Breyer-Brandwijk, 1932).

Recently Hakim (1951, 1952a) claimed very favourable results from the administration of *Celastrus paniculata* in cases of feeble-mindedness and impaired memory, basing his suggestion on records extending over a hundred years in a family practice. Similar reports are those of Dymock *et al.* (1890) and Kirtikar and Basu (1918), who write "the seeds are supposed to have the property of stimulating the intellect and sharpening the memory. The oil is used in the courts and colleges by a great many pundits and munshis to increase the intelligence of their pupils."

In the present experiment the seeds were employed. These are cinnamon brown in colour, about one-third of an inch in diameter and completely enveloped in a scarlet fleshy aril. The presence of an alkaloid in the seeds is mentioned by Wehmer (1931), and Chopra (1933) noted the presence of a glucoside and colouring matter in addition. The brownish powder covering the seed is rich in carotene. Basu and Pabrai (1946) isolated two alkaloids from the seeds, celastrine and paniculatine, and detected the presence of a resinous body. The former alkaloid has been known for many years (Mosso, 1891) to have a stimulant action on the brain not followed by secondary depression, and was considered by Tschirch to be identical with the active principle of *Catha edulis*. Because of their natural oil content the seeds form a sticky mass when crushed. This was filled into gelatine capsules, each containing 3 grains. Dummy capsules identical in appearance, size and weight, of an inert substance were also prepared. Hakim (1952a and b) recommends a dosage of up to 20 grains extending over a period of twelve weeks. The actual dosage employed was 6 gr. daily for four weeks, 12 gr. daily for four weeks and 21 gr. daily for four weeks.

Thirty-two patients were divided into an experimental and a control group. The two groups were matched by the pairing of patients according to sex and I.Q. on the Terman Merrill Revision of the Binet Scale Form L. Only Intelligence Quotients between 50 and 65 were included, and the patients' ages were in the 18-34 year range. Epileptics and those with a hospital stay of under twelve months were excluded, the latter to avoid improvement due to environmental changes. The medical, nursing staff and patients concerned were unaware which capsules actually contained the drug.

The following test battery was applied. General intelligence was tested by the Terman Merrill Revision of the Binet Scale—Form L before and Form M after treatment—the Porteus Mazes, Healy Picture Completion No. 1, and the Wechsler-Bellevue Picture Completion Sub-test. Visual memory was tested by a series of bead-stringing tests and a modified Whipple Test was used for the visual apprehension of common objects. Auditory memory was assessed by a digit repetition test and memory and learning by Digit Symbol tests and the Rey-Davis Form Board. Capacity for

sustained attention was measured by Digit and Letter Cancellation tests. Tests of addition, subtraction and mental arithmetic were given. A test of physical agility was employed. The Szondi personality rating was applied to all patients in both groups. The total number of tests both before and after treatment amounted to eighteen for each patient. The normal effect of practice was obliterated by comparison of the control and experimental groups after treatment.

Preliminary scores on the Terman Merrill scale revealed that the groups were well matched in respect of general intelligence, the Mean I.Q. of Group A (control group) being 58.82, and of Group B (experimental group) 58.13. The Terman Merrill ratings after treatment showed a high correlation between the groups, with a Mean I.Q. of 59.44 in Group A and of 58.69 in Group B. The scores of the two groups on both the Porteous Maze and the Healy Picture Completion tests showed a similar degree of improvement attributable to practice effect. The alternative material in the Wechsler Picture Completion test proved somewhat harder than that of Scale 1 originally used, but there was a corresponding decrease in the scores of both groups.

In the auditory and visual memory tests normal fluctuations in the results were found. The digit span was relatively stable in both groups before and after treatment. Some practice effect was noted in the re-test of visual apprehension of common objects, but this was the same for the control and experimental groups. In the bead-stringing test there was also no marked change in the performance of either group. Tests measuring the capacity for sustained attention, including digit and letter cancellation, and the writing of X's in a minute, showed improvement in both groups owing to the normal effect of practice and familiarity with the test situation. In the arithmetic tests of addition and subtraction no real difference in the scores of the two groups was observed, but on the mental arithmetic test the re-test scores of the experimental group were significantly higher than those of the control group. This test was composed of only ten verbal items, and it would seem undesirable to place too much weight on this finding in view of the relatively superficial and limited nature of the test, wherein all scores were low. Since no corresponding improvement is evident in the more discriminating addition and subtraction sections, it appears reasonable to assume that the change is merely of a fortuitous nature. Neither the test of physical agility nor the Szondi personality rating revealed any marked changes in either group after treatment.

The differences between the scores before and after treatment of both the control and experimental groups were compared; the re-test scores of both groups similarly dealt with, as were improvements in individual cases. For the purposes of statistical analysis the Students "t" test of improvement was applied to all these results, and no significant difference was found between the scores of the control and experimental groups apart from that found in the mental arithmetic test mentioned above. On twelve out of the seventeen tests the "t" scores showed a slight, though individually insignificant, improvement on the scores of the experimental group compared with those of the control group. This suggested that there is a minor, but hardly significant positive change in those treated. The number of variables to be considered is so large that in the investigation of small groups such minor changes should be classed as suspect.

Clinically, two patients in either group showed some general change in their behaviour pattern, being more co-operative and responding better to their social milieu. This was probably due to the extra care, attention and observation they enjoyed during treatment. No toxic effects were experienced, although insomnia and gastro-intestinal disturbances have been reported by others (Hakim, 1952b).

CONCLUSIONS.

Celastrus paniculata would appear to produce no significant improvement in the intelligence of feeble-minded persons. Administration in recommended dosage effects no major change in memory as has been claimed. The slight trend towards improvement of the treated group, however, suggests that further study might be justified.

We have to thank the East Anglian Regional Hospital Board for a grant in aid of this work, Dr. D. Russell-Davis, Department of Psychology, Cambridge University, for his advice on test methods and statistical analysis. We are indebted to Dr. S. A. E. Hakim, who supplied the seeds, and to Mr. J. R. E. Bevan, Assistant Clinical Psychologist, for his help in the psychometric investigation.

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Part II.—Reviews.

Conscience and Reason. By GRACE STUART. London: George Allen & Unwin, Ltd., 1951. Pp. 220. Price 15s.

This book is an interesting and orderly discourse of an intelligent person, reflecting the modern intellectual attitude to her subject; even though lost, she still holds to her faith in conscious reason and the "ego."

Sin is taboo to the religious, but the idea of sin is taboo to Mrs. Stuart. She suggests the concept of sin should be replaced by the concept of error.

Conscience is regarded in terms of the super-ego described by Freud and as "our old enemy, the super-ego."

Mrs. Stuart is quite against such antitheses as good and evil—such antitheses are an error, except of course the antithesis of Conscience and Reason.

Mrs. Stuart does not like the dualism of "St. George and the Dragon"; she does not appreciate fairy-tales or allegory. We must be mature. "The dragon is no longer to be slain, but to be humanized."

Search is made for "the civilizing factor," and the ability of Love to help the community solve its problems is stressed. Indeed, the outstanding impression given by the book is not only of brave reason but also of good conscience.

C. E. H. TURNER.

Problem Families in Bristol. By R. C. WOFINDEN, M.D., D.P.H. The Eugenics Society and Cassell & Company, Ltd., 1950. Pp. 60. Price 2s. 6d.

This excellent and informative little book in paper covers is the record of a Pilot Inquiry into problem families.

Apparently there are 80,000 problem families in England and Wales, containing approximately 300,000 dirty, satisfactorily healthy and not unhappy children. The mother is usually in poor health; the father does not go to work; the birth-rate is high, but not so the death-rate. They live in squalor.

A "whole army of welfare workers" assist these families in an un-coordinated way. "It is suggested that a small committee of officers should be set up with representatives from the health, housing, welfare, education and the children's departments—one or two officers of voluntary organizations could be co-opted." The responsibility for the work should be put on the welfare officer.

Parents brought before the courts for child neglect should be sent with their children to rehabilitation centres. Here the women learn to cook and sew and even to enjoy life. And here a weekly party of games "of the musical chair variety" has even "encouraged some of the somewhat drab mothers to tidy themselves up, to use make-up, even—the greatest triumph of all—it induced some to take out the curling pins which were perpetually worn, apparently against some great occasion which never arrived."

"Whatever long-term policy is adopted, the fundamental need is to make these individuals aware of their responsibilities and to help them to help themselves."

The root causes of the problem are not yet discovered.

The main object of this and other like inquiries was to try and standardize a suitable procedure of investigation, and to prepare the way for an authoritative committee such as an Inter-departmental Committee.

C. E. H. TURNER.

The Yearbook of Psychoanalysis. Volume 7, 1951. Managing Editor, SANDOR LORAND, M.D. New York: International University Press, Inc. Pp. 271. Price \$7.50.

When Freud broke through the barrier of the Unconscious Mind he found much that he admitted he could not explain. As for an hour, day after day, his patients lay on the analytic couch saying whatever came into their mind, he did not always know what they were talking about and neither did they. But this did not daunt Freud, who was like a general exploiting a "break through" without stopping to consolidate, nor heeding overmuch the chaos. His followers do likewise; and this

volume of the Year-Book of Psychoanalysis gives twenty-one examples of their energetic, thoughtful and stimulating work in this productive field.

Devotees will read the whole volume, but the general reader who has a detached yet lively interest in psychoanalysis is recommended to read the paper by Ernst Kris on "The Significance of Freud's Earliest Discoveries," which includes comments by Freud on his self-analysis, and the paper by Michael Balint on "Changing Therapeutic Aims and Techniques in Psychoanalysis."

Martin Waugh writes also, with perspicacity, on "Othello: The Tragedy of Iago."

C. E. H. TURNER.

Cerebral Mechanisms in Behavior. The Hixon Symposium, edited by Prof. LLOYD A. JEFFRESS. New York: John Wiley & Sons. London: Chapman & Hall, 1951. Pp. 311. 52s.

Here is a record of the papers presented, and the discussion that followed, when nineteen leading scientists met at the California Institute of Technology for a five-day conference. Though delivered in 1948, the contributions are by no means out of date, for the speakers were concerned chiefly with the present and future of cerebral physiology, and discussed not so much their past work as the problems that lay ahead. It can be said at once that the standard is high and almost every page worthy of study, which is not surprising, for the contributors include almost every leading worker in the subject.

Different readers will doubtless notice different emphases; my own reaction was to notice how much the discussion of cerebral mechanisms has moved from considering those simple, reflex-like, three-neuron structures that were studied a decade ago to considering those complex, learning, self-adjusting aggregates that are studied today. Professor von Neumann, for instance, in a brilliant survey of the present mathematical theory of computing machines, considers that "complexity" will have to be considered as a new factor in its own right: "With any reasonable definition of what constitutes an element, the natural organisms are very highly complex aggregations. The number of cells in the human body is of the order of 10^{15} or 10^{16} . The number of neurons in the central nervous system is of the order of 10^{10} . We have absolutely no past experience with systems of this degree of complexity. All artificial automata made by man have numbers of parts which by any comparable schematic count are of the order of 10^3 to 10^6 ." He considers that a new science will have to be created to handle, technically, the complexities of what happens in the brain to-day and what will happen in the computing machines of to-morrow. Professor McCulloch's paper discusses the same complexity as seen by the neurophysiologist. Then follows Professor Lashley, who supports whole-heartedly the view that the nervous system is dynamic in action and statistical in complexity: "Even the simplest bit of behavior requires the integrated action of millions of neurons; the activity of any single neuron can have little influence on the whole, just as the path of an individual molecule of a gas has little influence on the gas pressure." "I have come to believe that almost every nerve cell in the cerebral cortex may be excited in every activity. . . . Differential behavior is determined by the combinations of cells acting together rather than by cells which participate only in particular bits of behavior. The same neurons which maintain the memory traces and participate in the revival of a memory are also involved, in different combinations, in thousands of other memories and acts." Sixteen other contributors develop the theme in various ways.

Printing, binding and contents alike are excellent; the book can be recommended to all who are interested in cerebral mechanisms.

W. ROSS ASHBY.

Hormones, Psychology and Behaviour. Ciba Foundation Colloquia on Endocrinology, Vol. III. Edited by G. E. W. WOLSTENHOLME. London: J. & A. Churchill, 1952. Pp. 380. Price 35s.

The book contains contributions from thirty scientists, each an authority in his own subject, who met over several days in April, 1951, to attempt a review and a clarification of the many difficult and important relationships that link the endocrines and behaviour. Of particular interest to the psychiatrist will be the eight papers in Part II, on "Psychological and Behavioural Reactions Connected with Pathological Disturbances of Steroid Hormone Production."

The results, however, are somewhat disappointing, for the papers serve only to emphasize how meagre is our present knowledge and how much remains to be discovered. Rational methods of therapy are hardly within sight, for the many inexplicable variations and contradictions that are encountered show how many and important are evidently the factors that still remain to be discovered.

The book has the inevitable fault of scrappiness, for its several parts have no co-ordinating brain; but it has the advantage that it covers a wide field. Most of what is known is either described in the book or referred to, so the psychiatrist who wishes to find the present knowledge on some point may well find the book useful for providing him with either an authoritative article or at least with a starting point.

W. ROSS ASHBY.

The Diagnosis of Nervous Diseases. By the late JAMES PURVES-STEWART and C. WORSTER-DROUGHT. Tenth edition. London: Edward Arnold & Co., 1952. Pp. 962. 388 illustrations. Price 50s.

This book, which has been familiar to us all for many years, now appears in a new guise under the guiding hand of C. Worster-Drought. Before his death in 1949 Sir James was able to approve most of the work.

The book has been well brought up-to-date, and apart from a few small printers' errors is very well produced and a credit to the new author. It is more than twice the size of the original edition.

Will modern writers *never* get rid of the word *amentia*, which, we continually point out, in Holland corresponds to confusional insanity and in its Italian form "*amenza*" is, again, confusional states? The word *oligophrenia* has no ambiguous meaning and should be used.

There are few criticisms to make, but do modern neurologists really regard previous lead poisoning as one of the contributory causes of arterio-sclerotic dementia?

G. W. T. H. FLEMING.

Foundations of Neuropsychiatry. By STANLEY COBB. Fifth edition. 1952. Baltimore: The Williams & Wilkins Company. Pp. 287. Price 24s.

This well-known book needs no recommendation from us. It has always been a popular book, and now the author has added a chapter on general neuro-physiology and generally brought the remaining chapters up to date.

In the author's pyramidal diagram one would have liked to see some connecting lines (even dotted ones!) between clinical psychiatry and the basic sciences of physiology, neurology and experimental psychology. It is a pleasure to see the word feed-back appearing in a book dealing with psychiatry, and, as Brazier has said elsewhere, it is impossible to overestimate the changes that are taking place in our conception of the working of the nervous system.

The author gives a pithy account of the use (or misuse) of the words functional and organic. He wisely points out that—

(a) No biological process goes on without change of structure.

(b) Whenever the brain functions there is organic change.

(c) The brain is the organ of mind.

The implication in all this, viewed from the standpoint of psychosomatic medicine, should be obvious to all psychiatrists. Russell-Brain's "guess" that in the nervous system we are looking at the threads of a tapestry while in the mind we perceive the pattern is well put. One author points out that a sign for every thought is "too much to believe," and then tritely says that the 26 letters of the alphabet arranged in their various combinations and permutations "do remarkably well"! Altogether this is a most stimulating and provocative book.

G. W. T. H. FLEMING.

Abnormal Psychology. By D. B. KLEIN. A revised edition of Edmund Conklin's *Principles of Abnormal Psychology*. London: George Allen & Unwin, Ltd., 1951. Pp. 589. Price 40s.

This is a revision of Edmund S. Conklin's *Principles of Abnormal Psychology*, first published in 1927. A great deal of the book has had to be entirely re-written and this Professor Klein has done very well. The original book was very popular, and we are sure that this new edition will be just as popular.

The statement that "disorders of mental life serious enough to call for hospital care are known as psychoses" is surely rather misleading to the non-medical clinical psychologist. A great many non-psychotic mental illnesses call for hospital care (and get it), and if the beds and staff were available a great many more on both sides of the Atlantic would get it. There is also always a proportion of mild psychotic illnesses which do not receive hospital care.

The book is obviously written with a view to fulfilling the requirements of a university course in clinical psychology for clinical psychologists, but a great deal will be found to be of use to the general medical practitioner. The quotation of an account of electro-shock treatment experienced by a patient gives a very false picture to the reader. If that is how E.C.T. is administered in the United States it is high time something was done about it, and most certainly few people in this country after reading the account would allow themselves to be treated by E.C.T. Fortunately the account does not agree with the procedure in this country. We think the author would be wise to leave it out in a subsequent edition.

In the section on frontal lobe surgery undue prominence seems to be given to transorbital leucotomy—it is difficult for someone without clinical experience of psychosurgery to summarise the literature. The writer would have been better advised to refer his readers to one of the rather complete summaries that have been published elsewhere, and which should be easily obtainable in American libraries.

The reviewer is getting rather tired of drawing authors' attention to the ambiguous use of the word *amentia* for feeble-mindedness. The word is used in Holland for confusional insanity, and in the Italian literature "*amenza*" also means confusional insanity. *Oligophrenia* is much the better word.

G. W. T. H. FLEMING.

Psycho-surgical Problems. Edited by F. A. METTLER. London: Routledge & Kegan Paul, 1952. Pp. 357. Price 42s.

This is the second report of the Columbia Greystones Associates.

In this study several less common surgical procedures are described, including cortical venous ligation and thermo-coagulation. In addition transorbital lobotomy was one of the operations performed (on nine patients), and one which produced no physiological alterations.

The authors find that there is no permanent loss of intelligence after the surgical procedures here described. They can suggest no explanation for the discrepancy between these findings and those after non-surgical injuries, i.e., gun-shot wounds or neoplasms, where there is frequently intellectual impairment of varying degree. Goldstein's findings after frontal lobe tumours and head-injuries did not occur in this series of operations.

From a surgical standpoint thalamotomy presents a great deal of technical difficulty; one of the authors, after fifteen years of experience with the stereotaxic instrument, is very doubtful of its supposed accuracy.

There is a good discussion of the problems arising from psychosurgery, but so much remains to be done from an experimental standpoint.

G. W. T. H. FLEMING.

Problem Families: Five Enquiries. Edited by C. P. BLACKER. The Eugenics Society, London, 1952. Pp. 123. Price 5s.

The reader who glances through the book looking for information about the "problem family" is likely at first to be disappointed: when he reads the Preface and appreciates that the enquiries were made as a preliminary survey, as a "pilot" investigation, he will congratulate the editor and the society on producing a thoroughly useful set of facts. Would that all other statistical work proceeded as soundly! Since the method of the "pilot" investigation is still not known universally, a few remarks on its nature may be of interest to those who, having accumulated a mass of data, are thinking of subjecting it to some sort of statistical analysis.

There was a time when "statistics" was the play-ground of everyone who possessed a slide-rule. He would take some numbers from the records of admissions, or post-mortem records, or family histories, and he would proceed to compute percentages and to draw deductions. One still occasionally sees a paper laboriously analysing data that were collected as a mere by-product of some other activity.

In the early days of statistics such methods were justified, for nothing better was possible; but it cannot be too widely known to-day that such methods are obsolete.

The reason is that statistical techniques have become more expert and refined: if they are to show the full power of which they are capable to-day they must be supplied with data of adequate purity. The analogy with chemistry is illuminating. In the Middle Ages chemists had to use what materials they could get: dried sea-salt, spirits of wine, wood ash. But chemistry has advanced since then. The chemist to-day does not take such "chemicals," conduct his experiment, and then exert his powers to make allowance for the impurities: he insists on pure materials from the beginning. Now it must be recognized that the average collection of data commonly called "statistical" is as crude a mixture as sea-salt. Admissions to mental hospitals, recoveries under routinely-administered treatment, proportions of patients with associated diseases, discharge rates, for instance, give numbers that, while accurate from the auditor's point of view, are the outcome of an exceedingly complex interplay of factors: some large and obvious, some known to exist but of unknown size, some suspected, and, inevitably, some unsuspected. To work with such data is like trying to do chemistry with the "chemicals" that were used in the Middle Ages. Modern statistical methods demand purified data.

How are they to be obtained? There are two methods. One is deliberately to set up a small but well controlled experiment, that compensates for its smallness in size by its balance in design and by its strictness in the controls. Such is the method now used almost exclusively in well-conducted therapeutic trials. It demands the co-operation of the statistician from the first. The other method is suitable when such a small, accurate experiment is impossible: when we want, say, to study problem families, or road accidents, as they actually exist in society. Here the primary material is complex by whatever method it is studied. The method in this case is to conduct the investigation in two stages, the main part being prefaced by a "pilot" investigation, as, in chemistry, the main experiment is often prefaced by a preliminary purification of the chemicals. The "pilot" investigation is intended, not to find the answers to the main questions, but to enable the main investigation to be planned efficiently and intelligently, and in a form capable of giving a scientifically valid answer. It, too, demands the active participation of the statistician from the beginning. It may be objected that this method makes two pieces of work out of one, but the implication of wasted time is false. Social inquiries demand the winning of large quantities of information; and such large quantities, in suitably pure form, are not usually to be won successfully in a single stage: the attempt to get all at once often leads to results that are first suspected, and then ignored, so that the labour is, in fact, wasted totally. A more patient attempt, that proceeds by stages, can succeed where the other fails.

Dr. Blacker and his associates have followed the right method. They have explored the field, discovered the main sources of error, and examined them quantitatively. On the facts that they have established, a full-scale investigation can now be planned intelligently, with confidence that it will give results of scientific and social value. It is to be hoped that larger resources will be made available to them, so that their work may be completed. Meanwhile, all those who are concerned with the investigation of the "problem family" will find their book useful.

W. ROSS ASHBY.

The Contribution of Medicine to Our Idea of the Mind: The Rede Lecture, 1952.

By SIR RUSSELL BRAIN. Cambridge: The Syndics of the Cambridge University Press. Pp. 30. Price 2s. 6d.

This lecture was delivered at Cambridge on 7 May, and the change in our conception of the mind which has been brought about largely by medical writers in the present century was considered. It was pointed out that the medical man is always dealing with a body-mind unity, although often predominantly concerned with only one or the other. The neurologist and psychiatrist are faced with a more circumstantial aspect of the relationship, that between the mind and the brain. The abnormal rhythms appearing in an electroencephalogram and their possible implications in certain forensic situations are mentioned. Reference is made to the McNaghten Rules and, of course, to the fact that when lawyers and doctors discuss criminal responsibility each may find it difficult to appreciate the others' point of view. Perhaps this over-simplification was inevitable when addressing a lay audience.

But the reviewer believes that any discussion on this involved subject is misleading unless it exposes the differences which arise when eminent lawyers oppose the views of other lawyers of equal eminence, and doctors those of other doctors of equal standing, on almost every facet of this many-sided problem.

The general principles introduced by Freud receive brief notice, and the ethical difficulties which the unconscious mind has brought to light in our own time. Sir Russell Brain considers the physical basis of mind makes it the most vulnerable of all things in nature. He reminds us that—"In the past, men have been compelled by violence to act against their wills, but our contemporaries have learned how to violate the will itself. To employ fatigue or drugs to make a man accept ideas which he would normally reject, or to confess to offences which he has not committed, is the last derision of the mind, all the more deadly because it is apparently so easy."

NORWOOD EAST.

International Review of Criminal Policy. No. 1, January, 1952. United Nations Department of Social Affairs, New York. Pp. 135. Price \$2.00.

The Preface to the first volume of this review states that the United Nations hope that it will afford, at least in part, reliable world-wide information on the prevention of crime and the treatment of offenders. It aims to be a journal of applied criminological science rather than a scientific journal in the narrow sense, and it is not primarily a legal journal, although it recognizes that criminal law and procedure are major instruments of criminal policy. Emphasis will be attached to bibliographical material and technical information, and the publication will largely rely on the national correspondents of the Department of Social Affairs now being appointed. It also hopes to obtain voluntary co-operation of unofficial and interested persons and organizations at home and abroad, as well as copies of new publications. The Review will be issued twice yearly.

The present number deals with international activities in this particular sphere and the principal international non-governmental organizations concerned. Observations "On the International Comparison of Criminal Statistics" is discussed by Marc Ancel, and "Work Colonies in The Union of South Africa" by Louis van Schalkwijk. A comprehensive bibliography of current literature follows.

For a long time there has been need of such a publication. The first number of the Review shows the way in which this want may be fulfilled.

NORWOOD EAST.

The Earliest Stages of Delinquency. By H. EDELSTON. Edinburgh: E. & S. Livingstone, 1952. Pp. 200. Price 10s. 6d.

This psychiatric study by the Director of the Bradford Child Guidance Clinic is the result of fifteen years' experience. The book is divided into three parts. The first deals with the approach to the problem, the technique of the clinical examination and a general survey of the field. The second part considers treatment and adjustment at home, treatment by removal from home, and a short chapter on characterological disorders. The last part discusses the diagnosis, psychological factors and constitutional defects of delinquency. An outline of the generally accepted lines of treatment follows, and a more detailed account of newer methods, which Dr. Edelston considers are not so much appreciated or exploited but are more distinctive of the Child Guidance approach.

The book is clearly written and the thirty cases illustrating the text are well chosen. The author claims to have introduced in this study the psychiatric approach without losing sight of traditional moral standards. He considers that the part played by religious feeling in setting up many institutions for homeless children is unfortunately waning.

Those who are entering upon Child Guidance work as well as other social welfare workers will find the book useful.

NORWOOD EAST.

A Textbook of Abnormal Psychology. By R. M. DORCUS AND G. W. SHAFFER. Fourth edition. London: Baillière, Tindall & Cox. Pp. xvi + 717. Price 38s. 6d.

This is the fourth edition of a book we have all come to know well and admire. This edition has had added to it chapters on Brain Damage Disorders, Psychosomatic Disorders and the History of Mental Illness, together with a glossary.

There are a number of irritating mistakes which should have been avoided: i.e., in the glossary, anastomosis is not necessarily the union of two "hollow" structures by "operation." The structures may be solid and anastomose naturally. Abnormally slow heart beat is *bradycardia*, not *brachycardia*. *Deja Vu* is the impression of having seen something which *has* been seen before. Leucotomy is the section of any area of white matter in the brain, not now the "removal of small cores of brain tissue." A sarcoma can be a *very* malignant tumour. On p. 272, *pervitin* is *pervitin*, and *pneumophagus* is *pneumophagus*. Surely *neurasthenia* and *psychasthenia* are terms better discarded; they have been a dumping-ground for all sorts of conditions for years. Labotomy would no doubt be lobotomy and sodium amytal is sodium amytal.

In the new chapter on brain damage disorders, which is on the whole well done, we meet again the confusion between leucotomy and lobotomy. Small cores are no longer removed at different levels of the brain structure as a procedure constituting leucotomy.

Will modern writers *never* abandon the use of the word *amentia* for feeble-mindedness? The word is a confusing one, in Holland it is used as synonymous with confusional insanity and in Italy "*amenza*" is also confusional insanity. The word *oligophrenia* is surely now accepted.

The section on psychosurgery, which covers a page and a half, is very superficially dealt with and by no means up to date. It seems to us rather an unkind reflection on physical and chemical treatment to head the chapter "Treatment by Physical and Chemical Assault." The use of chemicals to provide sleep in a patient in good condition is sound psychology and sound medicine is most certainly *not* based on an over evaluation of the importance of sleep. The authors obviously have little experience of the terrors of insomnia.

We think that under the section dealing with psychopathic personalities some mention might have been made of the E.E.G. findings, which have an important relationship to the problems of juvenile delinquency. G. W. T. H. FLEMING.

Diseases of the Nervous System. By W. RUSSELL BRAIN. Fourth edition. London: Geoffrey Cumberledge, Oxford University Press, 1951. Pp. 1002. Price 42s.

The appearance of a fourth edition of this well-known and excellent textbook is very welcome.

In the chapter dealing with intoxication, the treatment of alcohol addiction by means of the conditioned reflex treatment and by means of *antabuse* might have been given at much greater length. The technique, contra-indication and dangers of these treatments are all well known now and there is an extensive literature. A summary of this would be invaluable either to the student who is asked the question of how to treat alcohol addiction, or the general practitioner who is faced with a case in his practice and has almost certainly not got any access to the literature on the subject.

As only some 130 cases of temporal arteritis have been reported in the literature during the past twenty years it may be considered a very rare condition and hardly worth a place in a text-book. If it is worth a place then a more complete description might have been given, including the mental symptoms.

These are, however, minor criticisms in what most of us have come to regard as our standard neurological text-book.

G. W. T. H. FLEMING.

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The Use of Methedrine in the Diagnosis and Treatment of the Psychoneuroses.

From the study of 140 cases it is concluded that d-N-Methylamphetamine hydrochloride or methedrine, when used in psychoneurotic illnesses, particularly in chronic

* A number of abstracts in this section are reproduced from *Chemical Abstracts*. To the Editors of this Journal we extend our grateful thanks.

anxiety states, neurodermatitis, and the acute post-traumatic anxieties, produces an emotionally free-flow material that may include painful memories of traumatic experiences, and that will provide the patient with permanent relief.

In the majority of cases the responses evoked are helpful, both diagnostically and therapeutically. (Authors' abstr.)

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*Psychopathology of Schizophrenia and Depression: I. <i>Huston, P. E., and Senf, R.</i>	131

A Psychological Study of a 106-Year-Old Man.

1. A case of a superannuated man, free of dementia despite his advanced age, is presented to illustrate that there is not necessarily a direct relationship between age and dementia. This man, on detailed study, was found to have high intellectual endowment and good emotional resources.

2. Dynamic concepts of ageing are discussed and the speculation presented that strong ego resources may play a role in resisting the onset of dementia in advancing age.

(Author's abstr.)

Psychopathology of Schizophrenia and Depression. I. Effect of Amytal and Amphetamine Sulfate on Level and Maintenance of Attention.

As part of a larger study of the relations among the primary symptoms of schizophrenia, this report is concerned with the attention disturbance. A reaction time technique employing two procedures, a regular and an irregular, was used to measure attention. In the regular procedure the length of the preparatory interval, that is, the time between a visual warning signal and an auditory reaction stimulus, was constant for all reactions to that interval. In the irregular procedure the length of the preparatory interval was varied randomly. Three intervals were used: 2, 5, and 10 seconds. This technique was applied to four groups of patients: 22 chronic schizophrenic, 20 early schizophrenic, 21 manic-depressive, depressive type, and 21 neurotic. All patients were tested without and with intravenous sodium amytal and amphetamine sulfate. Amytal alters the primary symptoms in many cases of schizophrenia.

The main results of the experiment were as follows:

1. Without drugs the chronic schizophrenic group was significantly slower in reaction time than the other 3 groups, and the neurotic group significantly faster, while the early schizophrenic and depressive groups were intermediate. With drugs the reaction time of the schizophrenic and neurotic groups slowed; that of the depressive group speeded.

2. Reaction times on the regular procedure were significantly faster than on the irregular for all groups at all preparatory intervals both with and without drugs, with the single exception of the 10-second interval without drugs for the chronic schizophrenic group. Here the reaction times on the regular and irregular were about the same. Under drugs, however, the chronic schizophrenic group also had significantly faster reaction times on the regular procedure at all intervals, including the 10-second.

3. An analysis of the percentage of patients who had the regular procedure faster than the irregular showed that without drugs the highest percentage was in the neurotic group and the lowest in the chronic schizophrenic group. Without drugs, as length of preparatory interval increases, the percentage of patients having the regular faster than the irregular declined; this was marked in the chronic schizophrenic group. Under drugs, in contrast, the percentage of patients who had the regular faster than the irregular was approximately the same for all diagnostic groups at each preparatory interval.

4. A "set index" of attention, based on the relation between the regular and irregular procedures, level of performance, and variability, without drugs, differentiated the chronic schizophrenic patients almost perfectly from the neurotic patients. Under drugs the set index of the chronic group showed a degree of improvement approaching significance.

5. An analysis of factors possibly related to the results indicated a slight correlation between co-operation and set index, changes in co-operation and changes in set index with drugs; and in the combined schizophrenic groups between duration of illness and set index. No relation was found between duration of illness and the separation of procedures, nor between schizophrenic subtype and the separation of procedures or set index.

From these results we conclude: (A) Level of attention is best in the neurotic group, poorest in the chronic schizophrenic group, with the early schizophrenic and depressive groups falling between. (B) Intravenous sodium amytal and amphetamine sulfate have a differential effect, improving the level of attention in depressive patients and making it poorer in the other three groups. Whether the explanation of this difference is primarily

physiologic or psychologic requires further investigation. (c) Having the regular procedure slower than the irregular on long preparatory intervals is a more prominent characteristic of schizophrenia and especially of chronic schizophrenia than of depression or neurosis. Hence schizophrenic patients, and especially chronic schizophrenic, have more difficulty maintaining a level of attention than depressive and neurotic patients. (d) Intravenous sodium amytal and amphetamine sulfate improved the ability of chronic schizophrenic patients to maintain a level of attention, as measured by the relation of the regular and irregular procedures. On a more complex measure of attention, the set index, schizophrenic patients showed some, but not significant, improvement with drugs. Hence the disturbance in attention in schizophrenia is not a unitary characteristic but has several aspects. (Authors' abstr.)

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Language Behavior in Manic Patients.

Specific findings in analyzing the speech of 10 manic patients were as follows:

1. There was persistence of the general framework inherent in spoken language. This was shown in terms of (a) the 10 most commonly used words, (b) the distribution range of various speech elements, and (c) the balance between conceptual and articulatory words.
2. There was a tendency to use fewer different words and to repeat these different words with greater frequency than in "normal" discourse.

3. There was a quantitative change in the use of certain speech elements, namely, (a) a relative increase in the use of pronouns, main verbs, and auxiliary verbs; (b) a relative decrease in use of adjectives and prepositions; (c) a high verb-adjective quotient.

4. The flow of speech in terms of rate, units of speech and units of silence was more uneven and was subject to wider variation than was "normal" speech.

On the basis of these findings a tentative descriptive analysis of language behaviour in manic patients is formulated as follows:

The language pattern of these manic patients indicates that gross disorganization does not appear at the level of structural elements, and that the dynamic laws demonstrable for any given language are operating. It is postulated that the defect of manic speech occurs at higher integrative levels of language formulation. A shift in emphasis in the use of elements of speech occurs in the direction of repetitiveness and homogeneity, and away from that part of the vocabulary which qualifies, differentiates, and individualizes. The interaction with the listener appears to be more characteristic of expressive behavior than of communication. If the assumption of a correlation between emotional states and verb-adjective quotient is correct, the manic patient's speech gives objective evidence of a heightened degree of anxiety. Greater variation, with less predictability and uniformity, occurs in the physical pattern of speech. (Authors' abstr.)

Psychological Functioning Following Cerebral Hemispherectomy in Man.

Early in the 19th century Francis Joseph Gall reported the case of a man in whom the right hemisphere had been destroyed by disease but whose "intellectual faculties remained intact up to the time of death." However, it was not until Dandy's first hemispherectomy in 1923, that operative procedures were carried out on such an extensive area in man. Since this pioneer operation there have been published reports on only 41 hemispherectomies, 28 done in this country, including Dandy's early series of 7 cases. With few exceptions the preoperative and postoperative psychological functioning of the patients has been described only in general terms, indicating the need for a systematic follow-up study with standard, objective psychological measures.

In the present study a man aged 54 had been operated on for an extensive brain tumor, and the entire right cerebral hemisphere was removed. Psychological examination could not be begun until the 18th post-operative day, because of the sequelae of the radical operation. On nine occasions during five months following operation the patient was examined with the Wechsler Memory Scale and various subtests of the Wechsler-Bellevue Intelligence Scale. Three months after operation the Rorschach test also was administered. The examination data reflect wide variations in functioning, with concreteness and perseveration of ideas, confused and psychotic-like thinking, clang associations, mingling of old and new information, and self-reference. Also seen are premorbid levels of superior vocabulary and verbal facility and extremely compulsive behavior.

A number of reports on post-operative psychological functionings have emphasized the absence of disturbance following hemispherectomy, the generalization being made from clinical observations. The present study by means of objective psychological measures reflects extreme variation and disturbance in the psychological functioning after operation. A similar systematic follow-up study in a number of cases is suggested in order that the course of recovery of psychological function after hemispherectomy may be portrayed more accurately. (Author's abstr.)

Phenomenon of Reduplication.

The phenomena of reduplication for place, person, and/or time in 16 patients with organic brain disease are defined and illustrated. One case is presented in detail.

The character of the pathologic process in the brain and the location of the lesions were varied. In all instances the electroencephalographic record showed bilateral diffuse delta activity.

Reduplication occurred as part of a general alteration in behavior, which included other types of disorientation for time and place, other confabulations, paraphasic language, and, in 12 cases, denial of illness or defect.

Reduplication was not explicable on the basis of a unitary defect, but appeared to be a manifestation of a pattern of functional reorganization in the damaged brain. The elements of the pattern are in large part determined by motivational factors.

Reduplicative manifestations in persons without demonstrable organic brain disease are described as occurring in déjà vu phenomena and the fantasies of children. The relation of these phenomena to those found in cases of organic disease is discussed. (Authors' abstr.)

N-Benzyl- β -Chloropropionamide (Hibicon®).

N-benzyl- β -chloropropionamide (hibicon®), a compound differing in chemical nature from other modern anticonvulsant drugs, has been found clinically and experimentally effective in the treatment of convulsive disorders.

Adequate control of convulsive seizures was achieved in 39 of 59 patients given clinical trial and hibicon®, supplemented by a barbiturate in 11. Of the 20 patients who failed to respond, 8 had never had adequate control of attacks on any anticonvulsant medication.

In a comparative study 70 per cent. of 31 patients had adequate control with hibicon® (plus a barbiturate in 7 instances), and 60 per cent. of the same patients had control with a hydantoin-barbiturate combination.

Hibicon® has been found singularly free from toxic reactions and from untoward side-effects. Consequently, patients whose seizures are equally well controlled with this and with other anticonvulsant medication feel better on hibicon® therapy.

The employment of hibicon® appears to widen the scope of the pharmacological therapy of chronic epilepsy, since it has successfully controlled the seizures in some patients whose attacks have failed to respond to all other present-day anticonvulsant drugs.

(Author's abstr.)

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Poliomyelitis. V. The Pons

Detailed histologic studies of the pons were made in 109 cases of bulbar poliomyelitis.

Histologic studies showed the pons to be involved in practically every case. This involvement consisted of both a diffuse interstitial-cell infiltration and neuronal damage. These changes occurred together in most cases, but differed greatly in severity and in distribution from case to case.

All the motor nuclei within the pons were about equally damaged, in moderate to severe alterations in these cell elements being shown in a little over one-half the cases. The degree of histologic damage far exceeded the amount of clinical dysfunction observed. This discrepancy may be due to the difficulty of examining the function of these nerves in an acutely ill patient.

Irritation of the motor nucleus of the fifth cranial nerve may result in severe trismus in bulbar poliomyelitis. This complication, by preventing the removal of secretions, may threaten the life of the patient unless an immediate tracheotomy is performed.

The upper half of the vasomotor centre is situated within the large reticular cells of the lower part of the pons. Involvement of this region of the pons can produce rapid circulatory collapse and death, in the absence of any medullary disturbances.

Contrary to the reports in the literature, the cells of the locus caeruleus were not involved in the authors' cases. (Authors' abstr.)

Poliomyelitis. VI. The Hypothalamus.

A clinicopathologic study of the hypothalamus was undertaken in 115 cases of bulbar poliomyelitis. Inflammatory changes were observed in 85 per cent. of the cases, and neuronal damage exceeding 5 per cent. of the cell elements occurred in 61 per cent. The hypothalamus appeared to be diffusely damaged; the supraoptic nuclei were most severely involved, whereas the tuberal and mammillary nuclei were usually spared.

During the acute illness many patients show clinical evidence of hypothalamic dysfunction, consisting of hyperthermia, hypothermia, hypertension, and gastric hemorrhage or stasis. Gastric hemorrhage must be considered one of the more serious complications of bulbar poliomyelitis, and may be the immediate cause of death in a patient who is apparently recovering from the acute illness. Gastric stasis can result in respiratory embarrassment and may also complicate recovery.

Months or even years after recovery from bulbar poliomyelitis patients will show evidence of subclinical damage to the hypothalamus, as evidenced by their abnormal response to special tests used to determine hypothalamic function. (Authors' abstr.)

Concentration of Cholesterol and of Lipid Phosphorus in Blood Serum in Multiple Sclerosis.

Total-cholesterol, free-cholesterol, and lipid-phosphorus levels were determined in the blood serum in 52 patients with multiple sclerosis and in 20 patients with other diseases of the central nervous system.

No evidence for the occurrence of hypercholesteraemia in multiple sclerosis was obtained. Possible reasons for the discrepancy between this result and that reported by other investigators are discussed.

The percentage of combined cholesterol in total cholesterol is normal in multiple sclerosis.

The concentration of lipid phosphorus in the patients with multiple sclerosis bore the same mathematical relation to the cholesterol concentration as that which has been reported in healthy persons.
(Authors' abstr.)

Use of Thiamylal (Surital®) Sodium with Electroshock.

The intravenous use of thiamylal (surital®) sodium immediately preceding the administration of electroconvulsive therapy is reported.

This technique appears to abolish muscular activity, or so to minimize it that the treatment may safely be administered to patients who have fractures or other bony lesions, which ordinarily contraindicate electroshock therapy.

The rise in blood-pressure and in pulse-rate following treatment is significantly less, and is the basis for the belief that this technique is safer for patients with a questionable cardiovascular state.

Anxiety of those patients who were fearful of electroshock treatment was reduced.

(Author's abstr.)

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The Electroencephalogram in the Electric Shock Therapies.

The following general conclusions may be drawn with respect to the effects of electro-convulsive treatment upon the E.E.G. :

1. Diffuse slowing and increased voltage of potentials are noted. These patterns often resemble epileptic discharges of the serial slow wave type, and in practically no instances do the characteristic " *petit mal* " type of spike and dome discharges appear.
2. The E.E.G. changes generally are most pronounced over the anterior aspects of the brain.
3. There is no direct correlation between the character of the post-electric shock E.E.G. pattern and the clinical response to treatment or the degree of memory disturbance.
4. With more frequent and greater number of treatments in a certain period of time, the greater is the E.E.G. abnormality.
5. The E.E.G. disturbances generally persist after the fifth or sixth treatment when administered on a thrice weekly basis, and usually disappear within one to three months after termination of an average course of treatment (six to twelve treatments).
6. There is no established relationship between the development of E.E.G. abnormalities and histopathologic changes in the brain.

(Authors' abstr.)

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The Localization of Aneurin Pyrophosphatase in the Brain.

That the localizations described represent the sites of enzyme action has been established with a fair degree of certainty by the absence of staining when aneurin pyrophosphate is omitted from the incubation medium ; by the suppression of staining when the magnesium ions are omitted, or when a low concentration of the inhibitor uranyl acetate is added ; and by heating or chemical treatment of the sections before incubation. The change seen in the localization of staining due to the replacement of the aneurin pyrophosphate by another phosphoric acid ester, such as 5-adenylic acid, provides further confirmatory evidence that enzymatic dephosphorylation of aneurin pyrophosphate has been demonstrated. It precludes the possibility of the pictures being produced to any appreciable extent by the deposition of the precipitate on foci of crystallization within the tissue (Naidoo and Pratt, 1951).

The activity detected in the present investigation appears to be distinct from that of non-specific phosphatases demonstrated by glycerophosphate. This activity has not been found in nervous tissue by previous workers who have used aneurin pyrophosphate as a substrate, presumably on account of their less favourable fixation methods.

The localizations obtained by the incubation of frozen dried brain tissue with aneurin pyrophosphate at pH 6.9 show certain similarities to those obtained with glycerophosphate at pH 5.3, but there are chemical and histological differences.

Tissue incubated with aneurin pyrophosphate at pH 5.3 or with glycerophosphate at pH 6.9 stains in each case at a greatly reduced rate. This difference in the pH optima, possibly explicable by differences in the physico-chemical properties of the two substrates, is large enough to suggest that it is an integral part of the conditions necessary for the demonstration of separate enzyme activities. Fluoride suppresses staining in the glycerophosphate medium, but has no effect on the rate of staining when aneurin pyrophosphate is used. When magnesium ions are omitted from the medium, staining is completely absent in the aneurin pyrophosphate medium but only reduced in rate when glycerophosphate is employed. It appears likely that the reaction demonstrated is the splitting of aneurin pyrophosphate to aneurin orthophosphate, since replacement of the aneurin pyrophosphate in the medium by aneurin orthophosphate or by inorganic pyrophosphate fails to produce positive results within the normal incubation period.

Although there is a similarity between the picture obtained with aneurin pyrophosphate and that with glycerophosphate, some histological differences are present. In the cerebral cortex layer VI is much less prominent than in glycerophosphate material and the nuclei of neurons do stain. The cells of the cranial nerve nuclei are more lightly stained than corresponding cells in glycerophosphate sections. In the cerebellum, basket fibres which stain with material incubated with glycerophosphate, do not appear. Bergmann glia, which do not stain in sections incubated with glycerophosphate, appear first and stain most deeply of all cerebellar structures. Similar intense staining of the Bergmann glia is found when adenosine triphosphate is used as the substrate. The choroid plexus stains moderately in contrast to the deeper staining found when glycerophosphate is used. A feature which appears in the aneurin pyrophosphate material but not in glycerophosphate incubated sections is the intimal staining of the larger vessels and arterioles. The discrete and granular appearances in the intima, however, do not necessarily indicate a particulate distribution of the enzyme.

The significance of these histological and biochemical differences is not immediately apparent. Although it is well established that aneurin pyrophosphate functions as a co-enzyme, the mechanism of its action is not clear. The biochemical study by Westenbrink and his colleagues of the breakdown by an alkaline phosphatase of aneurin pyrophosphate in a wide range of animal tissues does not directly assist in the interpretation of the present results. Further, these authors find that aneurin orthophosphate is split readily by this phosphatase, whilst the process now studied histologically in brain appears to be concerned more directly with the hydrolysis of aneurin pyrophosphate to aneurin orthophosphate and to be distinct from the action of non-specific phosphatases. Investigation of the conditions under which aneurin orthophosphate is hydrolysed to aneurin by brain tissue sections and the demonstration of the sites of this hydrolysis would be of value.

Banga, Ochoa and Peters (1939) find that the greater effectiveness of aneurin compared with that of aneurin pyrophosphate in stimulating the respiration of brain slices from aneurin-deficient animals can be explained by the failure of aneurin pyrophosphate to penetrate into the tissue. As aneurin is the diffusible form, at some stage dephosphorylation may be essential to the assimilation or further utilization of the vitamin. Thus sites of intense aneurin pyrophosphatase activity may indicate loci of high vitamin B₁ requirements. Alternatively, the enzyme localized at these sites may function in some more complex process specific to the vitamin but of a nature not yet understood. Although further anatomical study is necessary to determine in detail the degree of hydrolysis of the co-enzyme taking place in the various structures of the brain, it is of interest at this stage to note that the hypothalamus in general stains very deeply. (Authors' abstr.).

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Schizothymia-Cyclothymia as a Dimension of Personality.

Two hypotheses were investigated: (1) The functional psychoses (schizophrenia and manic-depressive insanity) are not qualitatively different from normal mental states, but form one extreme of a continuum which goes all the way from the perfectly normal, rational to the completely insane, psychotic individual. (2) The two main functional psychoses show patterns of traits which are observable in non-psychotic persons also, although in a less extreme degree, and which give rise to a continuum running from the extreme schizothyme to the extreme cyclothyme.

One hundred normal subjects, 50 schizophrenes and 50 manic-depressive patients were tested with a large battery of objective tests, and the significance of differences established by means of analysis of variance. Then factor analyses were performed on the inter-correlations of tests for the normal and the psychotic groups separately, and the method of criterion analysis used in order to verify deductions made from the original hypotheses. Hypothesis 1 was verified; Hypothesis 2 was not verified.

Certain general findings seemed of interest. (1) Scores of schizophrenes tended to be intermediate between scores of normals and scores of depressives. (2) Variances for psychotics are considerably higher than for normals. (3) Tests on which neurotics and normals had been shown to differ very significantly showed no differences between psychotics and normals. (4) Tests using expressive movements were particularly significant in differentiating between normals and psychotics.

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1. Biochemistry, Physiology, etc.

Electrocortical Effects of Topical Application of Acetylcholine Chloride to Human Cerebral Cortex. Chusid, Joseph G., et al. [*J. Applied Physiol.*, **4**, 764-70 (1952).]

Topical application of acetylcholine chloride, 10-20 per cent., to the human cerebral cortex via small cotton pledgets may induce severe local electrocortical changes. There is a latent period of 6-8 minutes followed by the occurrence of recurrent single high-amplitude negative waves. Then groups of negative waves or recurrent complexes composed of initial high-amplitude negative waves and rhythmic trains may occur. Early depression of local electric cortical activity was not noted. T. McKEE (Chem. Abstr.).

Electrolytes of the Cerebrospinal Fluid in Uremia, Tetanus, and Various Nervous and Psychic Syndromes. Sposito, M., et al. [*Arch. "E. Maralgiano" patol. e clin.*, **5**, 771-7 (1950).]

Values of Ca, K, P, Mg, Na, and Cl in 14 cases of uremia, 5 of tetanus, 8 of acute meningitis, 9 of brain tumors, 6 of epilepsy, 5 of cerebrovascular syndrome, 14 of luetic syndrome, 13 of myelitis cervicalis, 3 of neuritis, and 19 of various psychopathies are tabulated. In uremia the content of Na in cerebrospinal fluid was lower than that of blood. In tetanus a constant decrease in the Ca level was noted. An increase of P and K was observed in inflammatory forms, a decrease of Ca and Mg in degenerative and tumoral forms. In epilepsy there was only a slight decrease in Mg. C. SCANDURA (Chem. Abstr.).

Ultraviolet Spectrophotometric Studies on the Cerebrospinal Fluid in Normal and Psychotic Individuals. Seguin, F. [*Can. Med. Assoc. J.*, **64**, 51-2 (1951).]

Cerebrospinal fluid (I) was obtained by lumbar puncture, buffered to pH 7, and examined for light absorption in the range 250-320 m μ . Peak absorption for (I) schizophrenic patients was at 269-270 m μ , while that for controls was around 276 m μ . The difference between absorption at 268 m μ by (I) of schizophrenics and (I) of normal patients was statistically significant. Correction for the protein content of (I) did not alter the interpretation. The difference was tentatively attributed to above normal amounts of nucleoside and nucleotide in (I) of schizophrenics. W. DONALD GRAHAM (Chem. Abstr.).

Excretion of 17-ketosteroids in some Mental and Nervous Diseases. Ottonello, P., et al. [*Riv. sper. freniatria*, **75**, 69-77 (1951).]

In 13 cases of manic-depressive psychosis, 7 of schizophrenia and hypochondria, 10 of psychasthenia, 8 of muscular dystrophy and 9 of various other diseases the daily urinary excretion of 17-ketosteroids was 2.94-31.48, 4.70-20.48, 7.65-15.25, 3.27-17.13, and 5.84-23.42 mgm. respectively. C. SCANDURA (Chem. Abstr.).

Photometric Method for Testing the Presence of Iron in the Central Nervous System. Wolemann, M. [*Acta Morphol. Acad. Sci. Hung.*, **1**, 127-32 (1951).]

Sections of brain, 40 and 20 microns thick, were measured photometrically, after development of Prussian blue and Turnbull blue, for the determination of Fe. Average results (mg. per cent.): substantia nigra 14.5, globus pallidus 13.8, nucleus dentatus 5.9, red nucleus 6.0, cerebral cortex 5.25, tegmentum pontis 4.5, medulla oblongata 3.2, spinal cord 3.0. WILLIAM M. MCCORD (Chem. Abstr.).

The Uses of Nuclear Degeneration in the Diagnosis and Treatment of Brain Tumor. Sweet, W. H. [*New Engl. J. Med.*, **245**, 875-8 (1951).]

P³² injected intravenously as phosphate, became much more concentrated in brain tumors than in normal brain. K⁴² became more concentrated in most brain tissues than ¹³¹I in the form of diiodofluorescein. A disadvantage of K⁴², however, was its tendency to become concentrated also in muscle. For use in destroying brain tumors P³² is impracticable because it is taken up by liver and bone marrow as much as by brain tumors. B¹⁰ which captures slow neutrons and then disintegrates, injected in the form of borax, became

3-28 times as concentrated in brain cancers as in normal brain tissue for a short time (up to 0.5 hour) without producing toxic effects on the rest of the body.

MARION HORN PESKIN (Chem. Abstr.).

Gargoylism (Hunter-Hurler Disease, Dysostosis Multiplex, Lipochondrodystrophy). Prenatal and Neonatal Bone Lesions and their Early Postnatal Evolution. Caffey, John (Babies Hosp., New York, N.Y.). [Bull. Hosp. Joint Diseases, **12**, No. 2, 38-66 (1951).]

Pathological and biochemical aspects are described. At birth, serum Ca and P and urinary Ca may be normal, but lipides or glycogen are apparently deposited in the bones.

W. C. TOBIE (Chem. Abstr.).

Metabolism of Labile Phosphorus Compounds in Brain Anemia under Conditions of Protective Inhibition. Gromova, K. G., et al. [Biokhimiya, **17**, 13-24 (1952).]

Most of the white rats after ligation of the carotid arteries showed convulsions, and died within 1-12 hours. The few without convulsions lived longer, up to 4 days. When the animals were placed in an atmosphere of 50 per cent. O for 6 hours, the number of convulsive cases decreased. During anemia, especially in convulsive animals, a disturbance was observed in the resynthesis of adenosine triphosphate because of O starvation, which lowered oxidative phosphorylation. After a sleeping dose of urethan, the P metabolism of the anemic animals was practically normal. Cooling the animals to 30-31° for 2 hours previous to ligation of the carotid arteries prolonged the life of the animals and prevented a profound disturbance in the metabolism of labile P compounds.

H. PRIESTLEY (Chem. Abstr.).

Psychophysical Correlations. VIII. Model Experiments on the Problem of Schizophrenia. N, N-Diethyllysergamide and Mescaline. Fischer, R., et al. [Schweiz. med. Wochschr., **81**, 817-19 (1951); cf. C.A., **44**, 4997b.]

Psychopathological and physiopathological studies with N, N-diethyllysergamide (I) and mescaline (II) produced intoxications simulating schizophrenia. The effect of (I) has a certain similarity to the hebephrenic status, while the (II) effect has catatonic features. In (I) administration the liver function is less disturbed than after (II) application; the Quick hippuric acid test (C.A., **34**, 1044³) is positive in (II) intoxications and in most cases of acute schizophrenia. The cinnamic acid test (Snapper and Saltzman, C.A., **43**, 2322h) leads to the detection of liver dysfunction with (I). Comparative studies with larvae of *Xenopus laevis* show that (I) is approximately 100 times more toxic than (II).

EUGENE MAIER (Chem. Abstr.).

Ethanolamine O-phosphoric Acid in Rat Brain. Ansell, G. B., et al. [Biochem. J., **50**, 241-6 (1951).]

The presence of ethanolamine phosphoric acid (I) in brain extracts has been proved. Since it is identified in chromatograms of extracts prepared from brain frozen *in situ* by liquid O, the substance could not be formed by post-mortem breakdown of phosphatidyl ethanolamine (II). The recovery of the substance on 2-dimensional chromatograms is not quantitative. When rats are injected with $\text{KH}_2\text{P}^{32}\text{O}_4$ and killed after a few hours, the specific activity of the P in the brain (I) is many times greater than the specific activity of the P in the ether-soluble phospho-lipide. Radioactive (I) was isolated from minced brain respiring in labeled $\text{KH}_2\text{P}^{32}\text{O}_4$, leading to the conclusion that the substance is synthesized in the brain. Its role in brain metabolism is not clear. In view of its high P turnover in intact brain the possibility that it serves as a precursor of (II) cannot be excluded.

S. MORGULIS (Chem. Abstr.).

2. Pharmacology and Treatment.

Preliminary Observations on Mental Disturbances Occurring in Patients under Therapy with Cortisone and Adrenocorticotrophic Hormone (ACTH). Clark, L. D., et al. [New Engl. J. Med., **246**, 205-16 (1952).]

Ten cases of mental disturbance occurring during the course of therapy with ACTH and cortisone are reported. In five cases the mental disturbance coincided with the peak in increase of body weight. No correlation was noted of mental changes with dietary Na intake, KCl administration, 17-ketosteroid excretion, intracellular K, or changes in the serum levels of Na, K, Cl, or CO_2 .

MARION HORN PESKIN (Chem. Abstr.).

Free Amino-acids in Rat Brain during Insulin Shock. Cravioto, R. O., et al. [Proc. Soc. Expt. Biol. Med., **78**, 856-8 (1951).]

Brain extracts of rats subjected to insulin shock show, as compared with normal controls, smaller amounts of free glutamic acid, γ -aminobutyric acid, and glutamine, and a greatly increased quantity of free aspartic acid, but practically no change in total free amino-acid N.

L. E. GILSON (Chem. Abstr.).

Effect of Intravenous Papaverine Hydrochloride on the Cerebral Circulation, Jayne, H. W., et al. [*J. Clin. Invest.*, **31**, 111-14 (1952).]

Intravenous papaverine-HCl, in a dose of 0.2 gm. administered in a period of 20 minutes, results in a 13 per cent. increase in cerebral blood-flow, a commensurate decrease in arterial-cerebral venous O difference, with no change in cerebral O consumption, and a decrease in cerebral vascular resistance and cerebral venous O tension. This may be due to a direct dilating effect on cerebral vessels.

JOHN T. MYERS (Chem. Abstr.).

My 301, a New Muscle Relaxant. Gycha, F. P. [*Med. Monatsschr.*, **6**, 166-71 (1952).]

This drug is a 5 per cent. solution of guaiacol glycerol ether with 5 per cent. levulose of pH 4.3. It does not cause venous thrombosis on intravenous injection, has no effect on circulation, and has no hemolytic action. Because of its low toxicity it is recommended as an adjuvant for general anesthesia.

A. E. MEYER (Chem. Abstr.).

Acute Barbiturate Poisoning. Silver, Arthur W., et al. [*J. Phila. Gen. Hosp.*, **3**, 69-77 (1952).]

The present-day analeptics are not specific antidotes, but physiological antagonists, to barbiturates. Metrazole is the safest and most effective while picrotoxin is dangerous.

JOSEPH S. HEPBURN (Chem. Abstr.).

Anticonvulsant Activity of Carbamate Esters of Certain 2, 2-disubstituted 1, 3-propanediols. Berger, F. M. [*J. Pharmacol. Exptl. Therap.*, **104**, 229-33 (1952); cf. *C.A.*, **45**, 265a; 46, 1651d.]

The intensity and duration of the anticonvulsant action against electroshock seizures in mice were determined for the 2,2-disubstituted diethyl, methylethyl, methylisopropyl, diethyl, ethylbutyl, ethylphenyl, dipropyl, and diphenyl derivatives of 1,3-propanediol. The diols and their monocarbamates were short-acting and weak. The dicarbamates showed a longer and stronger anticonvulsant action. The cyclic carbonate esters, which may also be called 5,5-disubstituted 1,3-dioxan-2-one derivatives, showed a weak and transient anticonvulsant action.

L. E. GILSON (Chem. Abstr.).

Decurarization by Decamethonium. Hunter, O. F., et al. [*Brit. J. Pharmacol.*, **6**, 691-5 (1951).]

Suitable doses of decamethonium restored neuromuscular transmission after block by *d*-tubocurarine. This decurarization was not due to inhibition of cholinesterase by decamethonium. Transmitted responses appeared without a detectable increase in size or prolongation in the time course of the end-plate potential.

RICHARD F. RILEY (Chem. Abstr.).

THE ROYAL MEDICO-PSYCHOLOGICAL ASSOCIATION.

(MAUDSLEY BEQUEST.)

The Royal Medico-Psychological Association has initiated a scheme of two-day lecture courses suitable for psychiatrists in training and others interested in the subjects to be discussed. Admission is by ticket and free to members of the Association; the fee for each course to non-members is 10s. Regional Hospital Boards are being asked to give favourable consideration to the granting of study leave for these courses.

The first course will be held at 11, Chandos Street, Cavendish Square, London, W.1, on 9th and 10th February, 1953.

Applications for tickets should be addressed to *The Registrar, R.M.P.A.*, 11, Chandos Street, Cavendish Square, London, W.1. (Accommodation is limited.)

PROGRAMME (FIRST COURSE).

9th February, 1953.

10.00 a.m. "Selective Indications for Physical Treatments." W. Mayer-Gross, M.D., F.R.C.P.

11.30 a.m. "Technique and Management of Insulin Shock Therapy," R. Freudenberg, M.D.

- 2.00 p.m. "*Convulsion Therapy in Hospital Patients.*" L. C. Cook, M.D.
3.30 p.m. "*Out-Patient Convulsion Therapy.*" E. B. Strauss, M.D., F.R.C.P.

10th February, 1953.

- 10.00 a.m. "*Muscle Relaxants in Convulsion Therapy.*" Gerald Garmany, M.D., M.R.C.P.
11.30 a.m. "*Drug Abreactive Techniques.*" Stephen Horsley, M.R.C.S., L.R.C.P.
2.00 p.m. "*Leucotomy in the Neuroses.*" Desmond Curran, M.D., F.R.C.P.
3.30 p.m. "*CO₂ and Acetylcholine Therapy in Neuroses.*" William Sargent, M.B., F.R.C.P.

Each lecture followed by questions and general discussion.